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CREATIVE THINKING IN CHILDREN AT THE JUNIOR HIGH SCHOOL LEVELS.

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THIS PROJECT INVESTIGATED THE FACTORS OF "DIVERGENT PRODUCTIVE THINKING" WHICH CONTRIBUTE MOST TO CREATIVE BEHAVIOR. TWO JUNIOR HIGH SCHOOLS WERE INVOLVED. ONE WAS RELATIVELY LARGE, IN A MODERATE-INCOME AREA. THE OTHER WAS SMALLER, AND WAS SITUATED IN A PROFESSIONAL COMMUNITY. IN THE SMALLER SCHOOL SOME 220 STUDENTS WERE TESTED IN TWO 3-HOUR SESSIONS. SOME SUBJECTS WERE DROPPED FROM THE SAMPLE BECAUSE THEIR RECORDS WERE INCOMPLETE, RESULTING IN A SAMPLE OF 204 WITH A FULL RANGE OF NINTH-GRADE STUDENT IQ'S REPRESENTED. IN THE LARGER SCHOOL 700 STUDENTS WERE TESTED IN 2-HOUR SESSIONS. ELIMINATED FROM THE STUDY WERE ANY EXAMINEES WHO WERE NOT PRESENT FOR ALL THREE TESTING SESSIONS, OR FOR WHOM SCHOOL RECORDS WERE INCOMPLETE. FROM THE SELECTED GROUP OF A SAMPLE OF 229 BOYS AND 228 GIRLS WITH AN IQ RANGE OF 95-119 WAS FORMED. FURTHER RESEARCH SHOULD BE CONDUCTED TO ASCERTAIN WHETHER ABILITIES OTHER THAN THOSE RELATED TO DIVERGENT PRODUCTION CAN BE DIFFERENTIATED AT THE JUNICR HIGH SCHOOL LEVEL, TO EXPLORE THE DIFFERENTIATION OF ABILITIES AT YOUNGER AGE LEVELS, AND TO DETERMINE THE PREDICITVE VALIDITY OF TESTS OF DIVERGENT PRODUCTIVE THINKING. (JL)

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Cooperative Research Project No. 737

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INTRODUCTION

The Problem

Educators are becoming aware of the fact that standard intelligence tests, while useful in prediction of success in school, have serious limitations when identification or prediction of creativity is attempted. The problem of this study was to investigate basic abilities with the hope of eventually improving the procedures for the identification of the gifted child by including measures of intellectual attributes not found in the usual tests of intelligence.

The complete solution to this problem would entail at least two types of investigation. The first step would be to discover which of many possible relevant abilities can be measured in children. The second step would be to determine whether those abilities are related to particular kinds of performance which might be classified as "creative" or "gifted." The study reported here is concerned with the first step only. The demonstration that factors of intelligence other than those in the cognitive category may be differentiated in junior-high-school populations would also have implications for curriculum and guidance practices generally.

The most promising type of abilities to investigate seemed to be among those classified as "divergent productive thinking." The divergent-production abilities are believed to be uniquely important for creativity and have been relatively neglected in both the assessment and education of children. A number of divergent-thinking abilities have been identified in a military officer-candidate population. It is important to know whether the elaborate but systematic array of intellectual abilities found in adults also applies to subjects of younger ages and to both sexes.

There were two major objectives of this study:

A. To determine which factors of divergent production differentiate individuals at the ninth-grade level.

   1. To determine the relationship of these factors to measures of general intelligence.

   2. To determine whether these relationships for boys differ from those for girls.

B. To explore the differentiation of factors of divergent production in a population with higher-than-average intelligence as measured by standard tests.

The ninth-grade level was selected because it was believed that tests developed for adults might also apply at that level and because this level is critical for guidance into specialized education.

A Few Selected Studies

Because of the recent, wide interest in "creativity," there exists an increasing but limited body of literature in which that concept is involved. Our review is a highly restricted one, covering our own factor-analytic investigations in that domain, two studies dealing with validation of tests developed in this project, and four fairly recent investigations of differentiable aptitudes in children. Our intention is not to present a comprehensive review of even these restricted areas, but rather to locate the present study in the stream of studies on creativity.

Research on Creative Aptitudes

Since 1949, the Aptitudes Research Project at USC has been engaged in factor-analytic investigations of human intellectual abilities. Among the broad areas of ability which have been studied are reasoning, planning, evaluation, problem solving, and creativity. One outcome of these studies, particularly pertaining to the last named, has been a rather wide use of tests of "creativity" by other investigators, often as criteria in connection with research on training methods or as a means of differentiation of groups as an identification procedure. A possible objection to such uses, especially with children as subjects, is that the tests had been factor-analyzed using high IQ, young, adult males from a military population, and the tests might have somewhat different factorial content if used in other populations.

Our research on creative thinking led to its definition in terms of several rather distinct kinds of aptitudes, including factors of fluency, flexibility, originality, elaboration, redefinition, and sensitivity to problems. In our view, no one of these alone provides an adequate coverage of the broad process called "creativity." Individuals may have high scores on some but not on others; we would prefer to think of the "creative person" as one of those rare people who has high scores on many or all of the various components.

A second major outcome of our work at the Aptitudes Research Project is the formulation of a theoretical model of human intelligence called the structure of intellect, which is devised in terms of parallels among the approximately 60 known, separate abilities we have been able to define as factorially distinct.

The abilities we have found are parallel in three ways, making a three-dimensional model appropriate. Abilities are parallel if they involve the same operation, the same content, or the same product, or any two of these ways. The kinds of operations recognized are cognition, memory, divergent production, convergent production, and evaluation. Of these terms, only divergent and convergent production are new, although the others have new connotations and restrictions. Divergent production involves the generation of a variety of items of information in response to given information. Convergent production involves the generation of a well-determined "right" answer from given information. Contents are characterized as figural, symbolic, or semantic, with a fourth kind, behavioral, hypothesized but as yet with no empirical evidence. The outcomes of operations, or the things thought about, are called products and are recognized as units, classes, relations, systems, transformations, and implications. Figure 1 displays the geometric model.

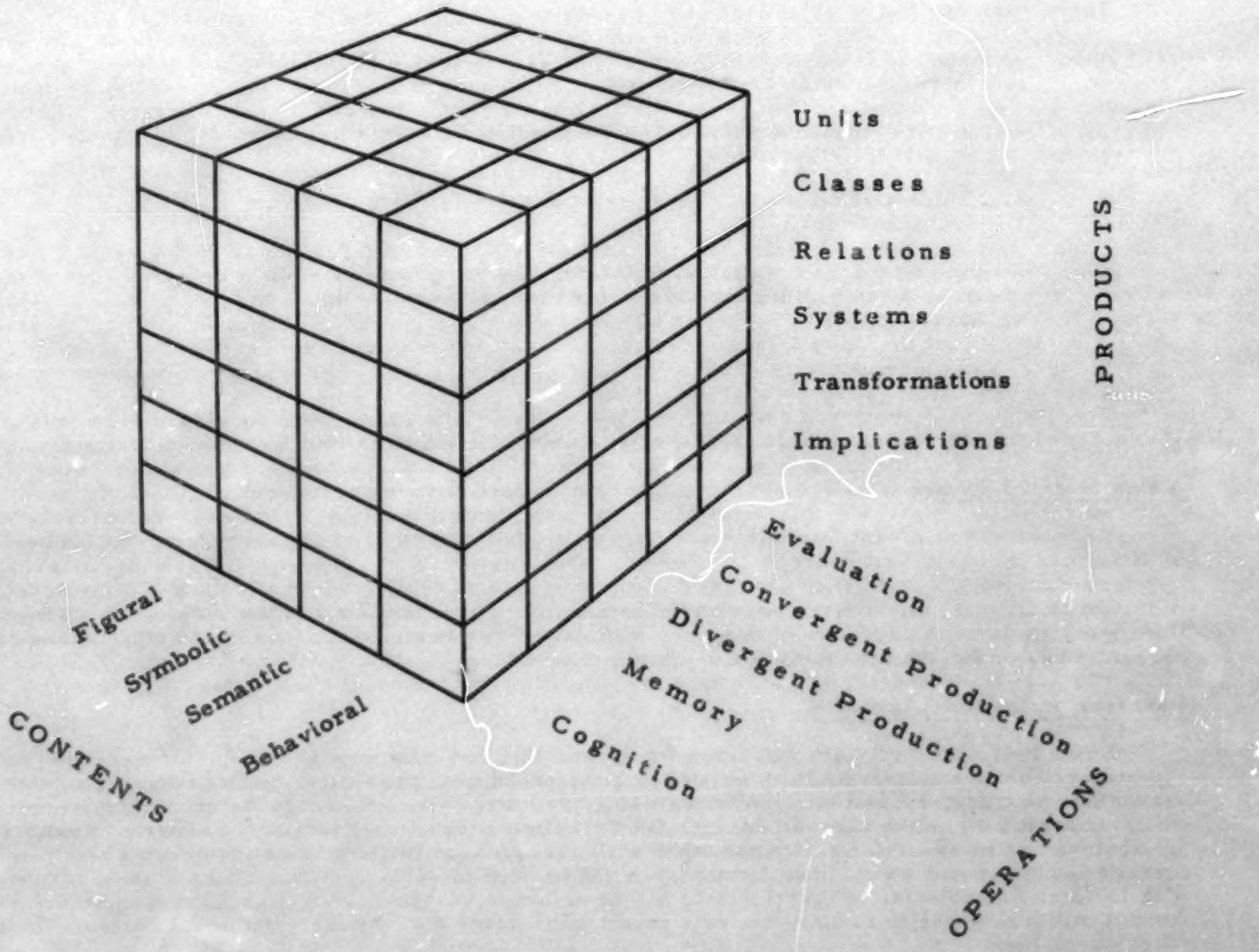

Figure 1

Theoretical model for the complete "Structure of Intellect"

Guilford and Merrifield (12) have presented a detailed description of the structure-of-intellect model, including recommended tests for each of the known factors. Our interest here is in those abilities contributing to "creativity," most of which require the divergent-production operation, characterized by the generation of many varied responses meeting a general objective or related to given initial information.

The fluency factors seem to have as products such things as units, relations, and systems; the flexibility-originality have to do with the production of classes or transformations; and elaborative thinking results in implications, e.g. outcomes, concomitants, or antecedents. A few abilities recognized as playing potential roles in creative performance are outside the divergent-production area. Two of them will be mentioned. Redefinition is described as convergent production of semantic transformations; sensitivity to problems is described as evaluation of semantic implications.

In the study reported here we concentrated on the factors with semantic content because they have been widely discussed and their tests have been used by other investigators and because, a more compelling reason, we know much less about divergent-production abilities for symbolic and figural content. One factor with figural content, adaptive flexibility, was included; another, which has been hypothesized on the basis of the model, is for figural implications. In the area of symbolic content, clarification of the factor of expressional fluency was sought.

Studies of Validation of Tests of Creative Aptitudes

Using a sample of aviation cadets, Zaccaria, et al. (27) found significantly non-zero correlations between measures of "creativity" similar to those in the present study and indices of creative activity derived from a biographical inventory. Significance in terms of an hypothesis of no correlation is of course no assurance that the measures have enough in common to permit useful prediction of one from the other.

Sprecher (13) collected measures of originality and ideational fluency using tests like those in this study and compared them with ratings of creativity made by the examinees' peers and supervisors. Supervisors also rated for creativity the responses of the examinees to realistic engineering problems. The criterion ratings were significantly predicted by scores from the tests, although the ratings of the answers to problems were more predictive. This result may have arisen from the "work-sample" nature of the problems.

Research on Aptitudes in Children

In an often-quoted study, Getzels and Jackson (5) compared responses to criterion tasks from two groups of secondary school students, those highest on IQ but not highest on scores from tests of some of the creative aptitudes represented in the present study and those highest on creative-aptitude scores but not highest on IQ. The mean IQ of the total group was well above the normal average of 100. They found that the second group gave more "creative" responses to the criterion tasks and were rated lower by teachers in terms of enjoying having them in class. IQ and creative-test scores predicted achievement-test scores about equally well.

Torrance (25) has reported a series of studies of growth in several aspects of creative performance. His studies, which have been cross-sectional in design, disclose fluctuations in the growth rates of this kind of behavior, and quite low correlations between measures of creativity and of IQ. Torrance has demonstrated that tests of fluency and flexibility of the type used in this study can be used successfully with children in grades 1 through 6 and that the scores are related to observed creative behavior.

In an attempt to ascertain whether abilities can be differentiated at pre-school ages, Davis and Lesser (3) administered tests of space, vocabulary, reasoning, number, and science knowledge to applicants for admission to the Hunter College Elementary School. Many of the correlations based upon 100 examinees about 5 years old were sufficiently low to support the idea that differentiable abilities were being measured.

Tate, et al. (24) found that, in seventh- and eighth-grade pupils, a composite related to word fluency, one of the factors with which we are concerned in the present study, made no significant contributions to the prediction of a "problem-solving" criterion based on verbal and abstract-reasoning test scores. Their composite for ideational fluency made a low, negative, but significant contribution. Their composite, which included Seeing Problems, as used in the present study, made a relatively large positive contribution to the prediction of the criterion.

Comment

The studies cited in the last two sections share the premise that tests factored in terms of high-level young, adult, male responses will measure the same aptitudes in other populations. This premise is essentially the notion of factorial invariance, a fundamental issue in the evaluation of factor-analytic methods. As a premise, it should not be assumed to be true, but rather should be tested empirically. Such a test is one of the objectives of this study.

HYPOTHESES

In summary, then, we proposed to apply the results of research on differential aptitudes in adults to the problem of differentiating ninth-grade students in terms of constructs other than that of the usual IQ. Our interest was restricted to divergent-production abilities. Our major hypothesis was:

H_1: A test battery representing different divergent-production aptitudes in adults will, when analyzed in terms of ninth-grade students' responses, exhibit a factor structure similar to if not identical with that which would be expected from adults.

Secondary hypotheses were:

H_2: The factor structure based on boys' responses will be the same as that based on girls' responses.

H_3: The factor structure based on responses from a high-IQ group will be the same as those based on responses from groups not having high IQ or a group unselected on IQ.

H_4: Means of scores obtained by a "gifted" group will not be different from means of scores obtained by an unselected group. The "gifted" student is defined as having an IQ of 130 or more, as is customary in California.

The selected, hypothesized factors are defined below, with the names of the tests used to represent them in this battery. The tests are described in the Appendix.

Description of Hypothesized Factors

CMU - Cognition of semantic units (verbal comprehension). Awareness of meanings of words or ideas.
- 30. S.A.T. Word Meaning
- 31. S.A.T. Paragraph Meaning
- 32. CAT Read. Voc.
- 33. CAT Read. Comp.
- 35. Verbal Comprehension

DMU - Divergent production of semantic units (ideational fluency). Production of many ideas appropriate in meaning to a given idea.
- 4. Consequences (obvious)
- 9. Ideational Fluency
- 19. Plot Titles (low)
- 28. Utility Test (fluency)

DSU - Divergent production of symbolic units (word fluency). Rapid production of a variety of words having a specified common structural element.
- 26. Suffixes
- 29. Word Fluency

DMC - Divergent production of semantic classes (spontaneous flexibility). Production of many categories of ideas appropriate in meaning to a given idea.
- 2. Alternate Uses
- 15. Multiple Grouping
- 27. Utility Test (shifts)

DMR - Divergent production of semantic relationships (associational fluency). Production of many relationships or associations appropriate in meaning to a given idea.
- 3. Associational Fluency I
- 14. Multiple Analogies
- 24. Simile Insertion

DMS - Divergent production of meaningful systems (not hypothesized, but emerged as distinct from DSS). Ability to produce a variety of ideational systems from a known set of idea units.

DSS - Divergent production of symbolic systems (expressional fluency). Production of a variety of symbolic systems using a given set of symbolic units.

7. Expressional Fluency
10. Make A Code
16. Number Combinations
25. Simile Interpretations

DMT - Divergent production of semantic transformations (originality). Production of a number of changes of interpretation, neither immediate nor obvious, that are appropriate to a general requirement.

1. Alternate Signs
5. Consequences (remote)
20. Plot Titles (high)

DFT - Divergent production of figural transformations (adaptive flexibility). Production of a number of changes of interpretation of figural or concrete material, which are neither immediate nor obvious, but are appropriate to a general requirement.

12. Match Problems II
13. Match Problems V
17. Planning Air Maneuvers

DFI - Divergent production of figural implications. Elaboration of given figural material.

6. Decorations
22. Production of Figural Effects

DMI - Divergent production of semantic implications (elaboration). Production of a number of antecedents, concurrents, or consequents of given information.

8. Figure Production
18. Planning Elaboration II
21. Possible Jobs

EMI - Evaluation of meaningful implications (sensitivity to problems). Deciding concerning the more crucial antecedents, concurrents, or consequents of given information.

23. Seeing Problems

MSI - Memory for symbolic implications (numerical facility, formerly NSI). Rapid recall of well-practiced implications, e. g. sums and products of numbers.

34. Numerical Operations

We had hoped that the cooperating schools would have available some criteria of "creativity" from which we might ascertain the validity of our factor tests. Unfortunately, none was at hand, and we felt it too much to ask to obtain an extensive set of ratings or other evaluations. We have also had experiences which have led us to question the useful validity of such ratings. The results we present are to be interpreted as demonstrations of the tenability of our hypotheses in terms of factorial invariance; questions of predictive validity for these tests at the ninth-grade level must remain for future studies.

PROCEDURES

Administration of Tests

Two junior high schools cooperated with us in this venture.[1] One was relatively large, in a moderate-income, metropolitan area; most parents were self-employed or small businessmen. The other was smaller, in what was once a college town, but is now becoming a bedroom community for subprofessional and professional employees of industry. Cooperation at both schools was outstanding. Class schedules for the examinees were modified for our convenience; the school principals had communicated a feeling of the importance of the research to their staff and students, with the result that high motivation was apparent.

In the smaller school we tested about 220 students in two three-hour sessions on two successive school days in December, 1959. Some subjects were dropped from the sample because their records were incomplete, resulting in a sample of 204 with a full range of ninth-grade-student IQ represented. This sample is hereafter referred to as sample T.

In the larger school we tested about 700 students, in three two-hour sessions on three successive school days in November, 1959. We eliminated from the study any examinee who was not present for all three testing sessions, or for whom school records were incomplete. From the selected group we formed a sample of 229 boys with an IQ range of 95 - 119, and a sample of 228 girls with the same IQ range. These are referred to as sample B and sample G, respectively. To the 141 students with IQ's of 120 or greater from the larger school, we added 65 with similar IQ's from the smaller school, to form a sample of 206, referred to as sample H.

The State of California specifies that students in a gifted program must have measured IQ's of 130 or higher. Therefore, those subjects in our study who would meet this criterion were combined and compared as a group with the middle-IQ groups. This sample is referred to as "Gifted."

The five samples which were analyzed separately are thus:

T - Total-Range IQ, N = 204
B - Middle-IQ Boys, N = 229
G - Middle-IQ Girls, N = 228
H - High-IQ Boys and Girls, N = 206
"Gifted" Boys and Girls, IQ 130 or more, N = 45

[1]We wish to thank Dr. H. Popenoe, Dr. Helen Rogers, Miss Nellie Wilson, and Mrs. Elizabeth Parmenter, of the Los Angeles City School District, and Mr. R. H. Oyler, Mr. E. C. Clemmer, and Miss Eleanor Knutson, of the Claremont Unified School District, for their cooperation with this study.

Scoring

Our objective was to ascertain the degree to which ninth-grade responses would exhibit the same factor abilities as adult responses. Thus we decided to adhere as strictly as possible to the scoring guides developed for adults. With the exception of four tests, we found adult guides were applicable and yielded score distributions appropriate to the Pearson-r model. The exceptions were Consequences and Plot Titles, both hypothesized as measures of originality, Planning Elaboration II, hypothesized as a measure of divergent production of semantic implications, and Planning Air Maneuvers II, based on an established measure of adaptive flexibility.

With respect to Consequences, although the total number of responses was about the same as for adults, the proportion of these judged remote (for originality) was noticeably less. However, we held to the same standard for remoteness and normalized the skewed score distributions prior to correlation. Plot Titles had been scored for clever and non-clever responses. There appears to be less humor, especially as indicated by puns or literary references, in the ninth-grade responses. Since we had placed the originality factor in the structure-of-intellect cell for transformations, we evaluated as "high quality" those responses evidencing a new or unusual interpretation of the given plots, or the encapsulation of the whole plot in a title both succinct and intriguing. Thus our Plot Titles (high) score fits well the structure-of-intellect category of transformations, although there was thus some departure from previous adult scoring procedures.

Adult responses to Planning Elaboration tend to emphasize operations or actions as details of a plan for a given situation. Ninth-grade responses tend to be lists of objects or material necessary to carry out the plan. We tried to maintain an analogous criterion for duplications, within examinees, of previously given responses, but the object-listing tendencies made this test rather similar to tests of our hypothesized factor of ideational fluency. The products emphasized seemed to be units rather than implications.

Earlier forms of Planning Air Maneuvers II had required the use of an answer sheet, an approach that had given some difficulty of interpretation in our 1955 study of planning abilities (2). For the present study we asked the examinees to sketch patterns of skywriting on the test booklets and rated the routes sketched for efficiency, the same criterion as in previous studies.

With these four exceptions, scoring of ninth-grade responses to adult forms was by adult standards. It should be noted that eight tests were new and had never been administered to adults. Scoring guides for them were developed at the time the tests were written and required little modification. Scoring this large battery for over 900 examinees required about 3600 man-hours, and was completed within a six-month period.

Analysis

Reliabilities were computed as Spearman-Brown extensions of alternate-form correlations where possible; the obtained values are of the same order as those from adult responses to the corresponding tests in previous studies. Results are presented in Table 1. Frequency distributions were inspected and, except for Consequences (remote) in all samples, and Plot Titles (high), and Utility Test (shifts) in sample T, were accepted as appropriate for Pearson-r intercorrelations. The score distributions for Consequences (remote) were normalized within each sample. The score distributions for Utility Test (shifts) and Plot Titles (high) were normalized in sample T only.

In all five samples the first 29 variables are the same; their descriptions, as noted before, appear in the Appendix. Measures of verbal comprehension differed: Test No. 35, Verbal Comprehension, was used in sample T; Nos. 30 and 31, from the Stanford Achievement Tests, in samples B and G; and Nos. 32 and 33, from the California Reading Tests, in sample H. No. 34, Numerical Operations, was available only for sample T. Samples T and H contained both boys and girls, so variable No. 36, Sex Membership, was included. The school difference in sample H was treated as variable No. 37.

We obtained information from each of the examinees on the occupation of the major wage-earner in his family and assigned a Warner index number to them. The mean index for all 598 examinees analyzed was 3.52; the Warner index is 1 for the highest socio-economic class and 7 for the lowest. The mean for sample T was 3.46, not significantly different from the grand mean at $p > .01$; the mean for sample B was 3.74, significantly lower than the grand mean, $p < .01$; the mean for sample G was 3.54, not significantly different from the grand mean. We have no explanation for the result that the Warner index mean for girls of IQ 95 - 119 is significantly higher than that for boys of the same IQ.

Table 1

Means, Standard Deviations, and Reliabilities of Scores

	M				σ				r_{tt}			
	T	B	G	H	T	B	G	H	T	B	G	H
1. Alternate Signs	9.83	11.59	11.84	12.10	3.25	3.83	3.66	3.53	.71	.78	.76	.75
2. Alternate Uses	15.77	19.94	18.79	21.21	6.64	8.25	6.81	7.01	.62	.85	.76	.78
3. Associational Fluency I	9.07	10.42	10.96	11.93	3.64	3.68	3.66	3.68	.44	.57	.62	.63
4. Consequences (obvious)	19.72	24.09	26.70	24.92	7.56	8.69	7.96	8.64	.75	.79	.75	.78
5. Consequences (remote)	54.22[a]	3.86*	3.83*	4.47*	20.45*	2.68*	2.76*	2.60*	.45	.52	.57	.56
6. Decorations	43.56	42.53	47.05	48.24	11.44	11.70	11.85	11.82	.73	.78	.81	.79
7. Expressional Fluency	22.07	25.78	29.07	30.82	11.95	11.67	11.75	12.38	.66	.66	.67	.67
8. Figure Production	34.00	35.83	35.41	34.62	8.20	8.14	8.29	7.84	.72	.78	.80	.78
9. Ideational Fluency	45.72	49.08	56.20	55.57	12.19	13.71	12.31	12.79	.71	.77	.68	.69
10. Make A Code	8.71	9.57	9.17	9.96	3.23	2.87	2.87	2.41	.40[b]	.31*	.21*	.47*
11. Marking Speed	49.04	53.94	54.73	53.46	9.87	9.99	8.83	8.56	.91	.88	.87	.88
12. Match Problems II	8.69	7.55	6.93	9.74	4.67	3.62	3.50	3.49	.70	.72	.71	.62
13. Match Problems V	11.00	10.33	9.60	12.61	4.40	4.07	3.87	3.56	.64	.63	.66	.52
14. Multiple Analogies	14.20	13.70	13.12	17.67	5.73	4.40	4.75	4.28	.76	.60	.66	.56
15. Multiple Grouping	6.73	6.76	6.80	7.82	2.59	2.43	2.32	2.25	.67	.52	.40	.41
16. Number Combinations	14.43	14.72	14.21	17.45	5.00	4.44	4.20	4.13	.82	.76	.76	.67
17. Planning Air Maneuvers	35.03	36.35	31.59	36.48	10.62	10.44	10.29	9.05	.71	.80	.74	.67
18. Planning Elaboration II	27.99	30.30	30.92	32.03	8.99	9.09	8.43	8.58	.70	.67	.63	.67
19. Plot Titles (low)	9.59	11.18	11.54	10.91	4.83	5.66	5.47	5.30	.79	.81	.82	.78
20. Plot Titles (high)	55.54*	3.73	3.63	4.19	21.82*	2.22	2.13	2.32	.44	.35	.47	.27
21. Possible Jobs	15.86	17.09	17.48	18.88	6.66	5.41	5.67	5.48	.78	.67	.67	.70
22. Production Of Figural Effects	30.25	32.49	32.80	33.00	7.58	6.63	7.02	6.98	.82	.70	.70	.69
23. Seeing Problems	26.29	27.26	25.74	31.11	8.44	7.74	8.27	7.44	.78	.78	.79	.74
24. Simile Insertions	10.65	10.50	11.59	13.80	4.43	4.63	4.78	4.23	.66	.66	.65	.50
25. Simile Interpretations	6.32	7.30	8.64	8.33	3.01	3.61	3.34	3.06	.70	.70	.63	.62
26. Suffixes	8.55	12.24	13.38	13.63	4.38	4.59	4.92	4.73	.51*	.44*	.48*	.54*
27. Utility Test (shifts)	5.10*	7.55	6.13	8.13	2.21	6.08	5.09	5.84	.42	.74	.65	.72
28. Utility Test (fluency)	21.96	23.86	23.54	23.47	7.59	8.73	7.61	8.15	.74	.76	.67	.75
29. Word Fluency	38.00	44.67	47.69	47.93	9.50	9.67	9.95	10.16	.68*	.67	.75	.74
30. SAT—Word Meaning		35.65*	35.41*			13.12*	14.31*			.58*	.62*	
31. SAT—Paragraph Meaning		28.76*	27.00*			15.32*	16.72*			.55*	.57*	
32. CRT—Vocabulary				34.89				6.81				.50*
33. CRT—Comprehension				42.39				11.30				.41*
34. Numerical Operations	35.43				15.24				.50*			
35. Verbal Comprehension	17.26				5.09				.61*			

[a] Data coded within samples for values marked*. These values not comparable across samples.

[b] Alternate-form correlations extended by Spearman-Brown formula except for values marked * for which communalities are entered.

Correlations of the Warner index with aptitude scores were significant for only two of the 29 aptitude measures, and only in sample G. The two tests were Alternate Signs and Possible Jobs. Because of the low values of the correlations, the Warner index was not included in the factor analyses.

Correlation matrices are presented as follows: For sample T, Table 2; sample B, Table 3; sample G, Table 4; and sample H, Table 5. The "Gifted" sample was too small to support a factor analysis.

In sample T, 18 factors were extracted and 16 were rotated; in samples B and G, 17 factors were extracted and 15 rotated; in sample H, 19 factors were extracted and 15 rotated. Unrotated and rotated factor matrices are presented as follows: sample T, Tables 6 and 10; sample B, Tables 7 and 11; sample G, Tables 8 and 12; and sample H, Tables 9 and 13.

The factor extractions followed the principal-factor solution, using squared multiple-correlation coefficients as estimates of communalities, as suggested by Harman (15).[2] The computer program used provides a varimax rotational solution. These solutions were inspected and set aside in favor of graphic orthogonal rotations by the Zimmerman method (28); graphic rotations permit a clearer differentiation of factors in batteries such as we had planned, with fewer tests per factor than the varimax procedure seems to require. The criteria of simple structure and positive manifold were met insofar as possible. Where alternative solutions presented some ambiguity, psychological meaningfulness was invoked to aid the choice.

The mean scores from the "Gifted" sample were compared, by Student's t-ratio test, with the means of all students taking all tests from one school, a total N of 639; 24 of the 45 "gifted" students were included in the total sample with which they were compared. The other 21 were from the other school. The results of this analysis are presented in Table 14.

While it is possible to compute indices of congruence of factor matrices, as discussed by Harman (15), their distribution characteristics are not yet known. Thus statements of probability relating to the findings may not be made. For this reason, we shall display the results in a manner that will facilitate comparison, and base our arguments upon the apparent similarities of the results in all four samples.

RESULTS

In the typical, simple, psychological or educational experiment, two groups of individuals are designated and subjected to differing experimental manipulations or treatments. The objective is to ascertain whether the difference in treatment results in a difference in some variable of interest which is more extreme than would be expected; the expectancy is based on chance variation, assuming the treatment had no effect on that variable. If the experimenter believes that some attribute other than the treatment used may contribute to obtained differences, he often matches the groups with respect to that variable, as a form of experimental control. Should the variable of interest be related to a number of the attributes, the experimenter may attempt to match the groups on all of them. The usual statistical test of his hypothesis is Student's t.

Many variables of interest to psychology and education may show differential effects as a result of several treatments applied within the same experiment. The separate and joint effects of such treatments in combination are usually determined by an analysis of variance, which leads to inferences about sets of mean values of the variable being investigated. The usual statistical test is the F-ratio, of which Student's t is a special case.

In contrast to inferences based on differences between means, correlational analysis attends to observed indices of agreement between measures from a single group of individuals. A high correlation is evidence that the two measures share some basic attribute with respect to which the individuals in the groups are different from one another: those with a high degree of the attribute tend to do well on both things measured; those with a low degree tend to do poorly on both. By similar reasoning, measures showing a low correlation with each other are presumed, for the most part, to measure different attributes. The effects of a particular treatment on some variable of interest may be tested by correlating a measure of degree or level of treatment with a measure of the variable. The usual test is again Student's t, using the standard error for a correlation

[2] All computations were carried out at the Western Data Processing Center, Graduate School of Business Administration, University of California at Los Angeles, using available programs for the IBM 709.

coefficient. Where several treatments are to be related jointly to a single variable, the usual technique is multiple correlation.

The factor analyst is not concerned with the effects of several treatments on just one variable. Rather he questions how the basic attributes contributing to correlations between measures differ from each other. Because differences between means of measures are not directly related to the magnitude of the correlation between them, one should not expect factor analysis per se to disclose that kind of evidence. Similarly, differences in variance are not directly contributory, so the results of a factor analysis will not indicate them. Two interwoven kinds of information are available from a factor analysis: the degree to which a measure is related to an attribute; and the degree to which measured attributes differ from each other.

The extreme of the first kind of information is the univocal test, one which measures but one attribute. The extreme of the second kind is a set of orthogonal factors, in which the attributes themselves are statistically unrelated, or independent, as evidenced when measures of one attribute have near zero correlations with measures of another.

A solution that maximizes both kinds of information is said to have simple structure, which was the major criterion of the solutions obtained in this study. The principal-component factors are an arbitrary set, arising from computational convenience, and cannot be assigned any explanatory meaning. The transformation of the set of extracted factors to factors exhibiting simple structure is accomplished by the procedure called rotation.

The objective of rotation is to transform all relations of factors to measures so that each factor has clear distinctness from others and also has reasonable psychological meaning. In graphic rotations, each step is to examine each pair of extracted factors and their relations with tests to find a new position for the pair so that some measures are related highly to each of the rotated factors and not to the other. This is essentially the condition known as "simple structure." The ideal simple structure is seldom achieved with respect to all measures and all factors in a battery.

The degree to which a measure is related to a factor is called its "loading." By fairly common agreement among factor analysts, there being no exact statistical test, a loading is said to be significant for purposes of interpretation if its value is .30 or greater. When the factors are kept at right angles with one another, a loading may be considered as the correlation of a measure with a factor. An ordinary correlation coefficient of .30 would be about three standard deviations from zero, for samples of 100 individuals. Loadings of .10 or less indicate the absence of a relationship between a measure and a factor. The psychologically meaningful interpretation of a factor is most convincing when the measures loading on the factor have no significant loadings on other factors (the measures are univocal). Good simple structure was achieved in all four analyses, but not all measures are univocal (they are by no means all univocal in any analysis).

A few words should be said regarding the kind of results to be expected from the kind of sampling that was made in three of the samples. In each case there is considerable restriction of range in IQ as compared with sample T, in which the more customary range of IQ's for ninth-grade students is left. If all the tests and factors were completely unrelated with IQ there should be no difference in the factor-analytic results. If there were considerable relationship of these kinds, restriction in range should result in a clearer picture of differentiated factors. On the other hand, if there is a small amount of relationship, as is evidently the case, essentially the same kinds of differentiation of factors should be apparent in all analyses but the factor loadings should be larger in sample T, for which the range was not restricted. The latter result will especially be commonly noted.

Interpretation of the Factors

In the following paragraphs, as each factor is discussed, the tests with significant loadings in any of the four analyses are presented. The results from all four samples have been grouped by factor. Significant loadings on factors other than the one being discussed are indicated in parentheses. The abbreviations are coded according to locations in the structure of intellect, which was described earlier. The complete tables of factor loadings are given in Tables 10 (sample T), 11 (sample B), 12 (sample G), and 13 (sample H). Test descriptions appear in the Appendix.

Table 2

Correlation Matrix, Sample T, Boys and Girls Full Range IQ *

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	34	35	36
1.		51	36	40	34	36	34	38	45	18	16	17	22	31	41	24	23	46	25	34	39	27	34	32	38	27	38	50	34	16	17	-06
2.	51		48	41	53	48	42	22	52	22	20	25	42	49	46	36	24	51	18	41	49	25	52	54	44	35	46	33	45	30	44	-08
3.	36	48		32	40	30	49	20	45	07	21	13	27	44	26	28	09	45	09	36	40	20	43	55	34	36	36	36	47	21	42	-09
4.	40	41	32		27	37	38	21	57	14	27	05	10	18	33	29	08	45	51	24	50	25	45	30	34	30	20	53	42	33	07	-29
5.	34	53	40	27		29	37	21	37	09	15	19	26	35	35	39	19	39	18	31	34	19	37	30	35	26	38	26	36	18	30	-09
6.	36	48	30	37	29		22	38	42	06	27	-02	25	28	22	16	17	39	13	27	32	35	34	33	17	28	30	25	25	10	18	-14
7.	34	47	49	38	37	22		14	56	09	18	30	25	46	34	35	17	40	13	28	33	19	42	44	39	38	26	39	56	31	40	-19
8.	38	22	20	21	21	38	14		27	00	22	02	17	15	11	11	30	31	12	16	12	30	24	14	19	11	26	24	14	04	-01	-10
9.	45	52	45	57	37	42	56	27		18	31	17	21	39	40	37	16	54	30	34	56	22	51	42	42	52	32	52	56	40	26	-37
10.	18	22	07	14	09	06	09	00	18		-05	42	15	17	37	16	07	23	08	16	14	17	16	15	18	07	05	14	20	14	09	-04
11.	16	20	21	27	15	27	18	22	31	-05		-08	09	20	11	12	10	26	03	15	18	14	22	17	20	23	17	18	26	32	13	-13
12.	17	25	13	05	19	-02	30	02	17	42	-08		38	28	36	36	26	12	-04	14	13	14	14	19	14	14	13	04	23	14	21	01
13.	22	42	27	10	26	25	25	17	21	15	09	38		44	30	38	42	24	01	17	23	12	33	29	12	20	22	15	24	13	26	07
14.	31	49	44	18	35	28	46	15	39	17	20	28	44		44	47	33	37	-12	44	38	09	43	54	36	37	29	22	39	34	63	-01
15.	41	46	26	33	35	22	34	11	40	37	11	36	30	44		36	24	38	14	28	34	20	30	40	26	18	31	25	34	17	25	-06
16.	24	36	28	29	29	16	35	11	37	16	12	36	38	47	36		30	30	06	26	41	12	43	35	29	30	16	22	32	43	29	-15
17.	23	24	09	08	19	17	17	30	16	07	10	26	42	33	24	30		16	-02	12	05	03	12	16	04	09	18	02	05	05	10	10
18.	46	51	45	45	39	39	40	31	54	23	26	12	24	37	38	30	16		35	28	44	31	51	42	40	38	39	47	44	34	30	-22
19.	25	18	09	51	18	13	13	12	30	08	03	-04	01	-12	14	06	-02	35		-01	22	24	22	01	26	-03	14	36	12	10	-15	-28
20.	34	41	36	24	31	27	28	16	34	16	15	14	17	44	28	26	12	28	-01		28	09	40	35	37	24	20	26	36	22	32	-02
21.	39	49	40	50	34	32	33	12	56	14	18	13	23	38	34	41	05	44	22	28		17	50	46	47	39	20	40	44	34	34	-30
22.	27	25	20	25	19	35	19	30	22	17	14	14	12	09	20	12	03	31	24	09	17		21	16	19	07	19	14	16	16	01	-09
23.	34	52	43	45	37	34	42	24	51	16	22	14	33	43	30	43	12	51	22	40	50	21		52	49	39	32	37	42	41	38	-23
24.	32	54	55	30	30	33	44	14	42	15	17	19	29	54	40	35	16	42	01	35	46	16	52		41	39	33	31	43	33	52	-15
25.	38	44	34	34	35	17	39	19	42	18	20	14	12	36	26	29	04	40	26	37	47	19	49	41		28	23	31	44	34	34	-33
26.	27	35	36	30	26	28	38	11	42	07	23	14	20	37	18	30	09	38	-03	24	39	07	39	39	28		21	23	56	35	35	-14
27.	38	46	36	20	38	30	26	26	32	05	17	13	22	29	31	16	18	39	14	20	20	19	32	33	23	21		27	31	18	24	02
28.	50	33	36	53	26	25	39	24	52	14	18	04	15	22	25	22	02	47	36	26	40	14	37	31	31	23	27		43	27	06	-18
29.	34	45	47	42	36	25	56	14	56	20	26	23	24	39	34	32	05	44	12	36	44	16	42	43	44	56	31	43		42	41	-22
34.	16	30	21	33	18	10	31	04	40	14	32	14	13	34	17	43	05	34	10	22	34	16	41	33	34	35	18	27	42		28	-27
35.	17	44	42	07	30	18	40	-01	26	09	13	21	26	63	25	29	10	30	-15	32	34	01	38	52	34	35	24	06	41	28		-01
36.	-06	-08	-09	-29	-09	-14	-19	-10	-37	-04	-13	01	07	-01	-06	-15	10	-22	-28	-02	-30	-09	-23	-15	-33	-14	02	-18	-22	-27	-01	

Table 3

Correlation Matrix, Sample B, Boys IQ 95-119 *

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1.		40	49	40	30	36	29	48	40	25	19	16	21	21	30	14	31	47	33	28	42	29	25	28	36	22	40	49	25	20	16
2.	40		40	33	50	37	37	32	39	22	22	17	19	32	22	15	22	33	23	39	34	30	44	43	43	28	44	26	30	40	27
3.	49	40		27	26	27	43	32	37	12	20	16	10	25	31	08	08	30	18	29	34	16	34	32	36	37	29	32	40	26	22
4.	40	33	27		28	21	33	16	48	16	23	03	19	14	16	17	13	48	53	29	36	20	34	25	43	12	26	45	36	16	-01
5.	30	50	26	28		23	27	26	32	18	07	13	15	16	14	24	15	36	17	32	17	30	38	36	33	23	39	31	26	28	22
6.	36	37	27	21	23		24	38	18	13	24	15	14	16	10	16	18	27	15	17	22	48	24	07	26	17	20	21	23	22	17
7.	29	37	43	33	27	24		35	41	21	27	-03	01	18	24	07	03	30	24	38	30	25	34	33	38	36	26	31	46	33	12
8.	48	32	32	16	26	38	35		29	28	26	21	24	14	17	05	29	28	26	20	28	37	25	17	32	24	30	29	27	13	07
9.	40	39	37	48	32	18	41	29		20	27	13	09	25	28	15	12	50	37	38	39	24	32	41	40	35	27	54	44	33	21
10.	25	22	12	16	18	13	21	28	20		18	-01	05	08	12	18	13	18	12	15	11	13	23	16	15	09	21	19	29	15	11
11.	19	22	20	23	07	24	27	26	27	18		07	12	05	16	13	07	22	23	07	16	14	18	21	19	19	17	14	28	14	03
12.	16	17	16	03	13	15	-03	21	13	-01	07		60	24	19	20	33	14	00	09	19	06	12	23	07	04	17	10	09	08	19
13.	21	19	10	19	15	14	01	24	09	05	12	60		16	21	24	23	18	10	11	18	14	12	16	11	01	16	13	13	09	09
14.	21	32	25	14	16	16	18	14	25	08	05	24	16		26	31	15	23	00	32	29	18	29	30	27	21	17	04	21	38	41
15.	30	22	31	16	14	10	24	17	28	12	16	19	21	26		17	20	21	13	14	26	08	09	17	19	15	19	28	21	24	20
16.	14	15	08	17	24	16	07	05	15	18	13	20	24	31	17		14	21	06	14	19	13	16	16	14	11	07	04	21	20	18
17.	31	22	08	13	15	18	03	29	12	13	07	33	23	15	20	14		08	12	04	09	20	04	12	15	01	14	12	02	08	06
18.	47	33	30	48	36	27	30	28	50	18	22	14	18	23	21	21	08		37	37	38	24	30	23	38	19	44	57	26	27	15
19.	33	23	18	53	17	15	24	26	37	12	23	00	10	00	13	06	12		37	02	27	19	19	08	34	07	33	35	19	01	-06
20.	28	39	29	29	32	17	38	20	38	15	07	09	11	32	14	14	04	37	02		30	24	35	35	36	29	26	25	34	28	20
21.	42	34	34	36	17	22	30	28	39	11	16	19	18	29	26	19	09	38	27	30		25	35	26	28	22	19	25	29	28	18
22.	29	30	16	20	30	48	25	37	24	13	14	06	14	18	08	13	20	24	19	24	25		22	10	26	15	23	20	19	23	16
23.	25	44	34	34	38	24	34	25	32	23	18	12	12	29	09	16	04	30	19	35	35	22		47	35	26	28	15	30	39	33
24.	28	43	32	25	36	07	33	17	41	16	21	23	16	30	17	26	12	23	08	35	26	10	47		31	34	32	19	34	39	31
25.	36	43	36	43	33	26	38	32	40	15	19	07	11	27	19	14	15	38	34	36	28	26	35	31		32	32	30	28	37	17
26.	22	28	37	12	23	17	36	24	35	09	19	04	01	21	15	11	01	19	07	29	22	15	26	34	32		17	20	48	25	20
27.	40	44	29	26	39	20	26	30	27	21	17	17	16	17	19	07	14	44	33	26	19	23	28	32	32	17		38	25	18	18
28.	49	26	32	45	31	21	31	29	54	19	14	10	13	04	28	04	12	57	35	25	25	20	15	19	30	20	38		31	17	00
29.	25	30	40	36	26	23	46	27	44	29	28	09	13	21	21	21	02	26	19	34	29	19	30	34	28	48	25	31		22	10
30.	20	40	26	16	28	22	33	13	33	15	14	08	09	38	24	20	08	27	01	28	28	23	39	39	37	25	18	17	22		59
31.	10	27	22	-01	22	17	12	07	21	11	03	19	09	41	20	18	06	15	-06	20	18	16	33	31	17	20	18	00	10	59	

* Decimal points have been omitted

Table 4

Correlation Matrix, Sample G, Girls, IQ 95-119 *

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1.		37	52	44	35	28	31	48	50	03	23	22	14	26	23	09	-01	45	25	35	32	20	29	29	31	31	34	48	37	21	20
2.	37		33	32	30	27	32	29	45	09	16	28	27	37	29	30	14	33	09	44	40	21	46	41	38	29	43	27	23	40	36
3.	52	33		29	33	23	33	36	43	07	17	15	08	26	22	15	14	35	15	27	23	15	23	39	37	30	29	32	37	28	27
4.	44	32	29		15	26	26	24	54	11	27	06	16	15	21	12	06	45	45	22	37	21	34	11	45	19	21	50	27	13	09
5.	35	30	33	15		22	28	24	29	02	14	14	17	21	11	10	04	27	09	28	25	18	28	32	18	19	35	21	27	31	19
6.	28	27	23	26	22		28	41	40	12	23	27	32	28	29	20	07	22	17	26	21	38	21	19	23	16	16	10	27	20	16
7.	31	32	33	26	28	28		21	41	13	21	15	19	29	18	15	06	28	18	30	26	22	18	32	34	40	22	18	47	32	13
8.	48	29	36	24	24	41	21		34	01	18	16	21	24	14	09	08	29	24	23	22	22	23	24	19	17	24	21	30	12	21
9.	50	45	43	54	29	40	41	34		16	32	22	22	34	38	18	09	42	23	30	41	21	38	28	45	38	31	49	45	32	21
10.	03	09	07	11	02	12	13	01	16		13	13	19	01	09	10	12	13	16	08	13	03	02	-10	08	07	12	13	12	04	04
11.	23	16	17	27	14	23	21	18	32	13		17	14	-03	26	16	06	20	16	15	14	13	16	14	16	15	15	22	27	13	11
12.	22	28	15	06	14	27	15	16	22	13	17		53	27	18	24	28	13	05	16	10	13	17	12	08	23	18	13	22	15	25
13.	14	27	08	16	17	32	19	21	22	19	14	53		33	21	38	24	19	12	12	27	16	20	10	10	17	29	13	24	17	26
14.	26	37	26	15	21	28	29	24	34	01	-03	27	33		19	36	13	12	-02	27	27	22	26	37	27	42	15	02	34	38	40
15.	23	29	22	21	11	29	18	14	38	09	26	18	21	19		14	14	21	08	15	19	14	24	23	26	26	29	17	20	26	20
16.	09	30	15	12	10	20	15	09	18	10	16	24	38	36	14		21	06	-04	26	26	16	27	27	21	34	09	00	34	35	39
17.	-01	14	14	06	04	07	06	08	09	12	06	28	24	13	14	21		06	11	08	13	14	14	14	05	14	09	07	17	03	12
18.	45	33	35	45	27	22	28	29	42	13	20	13	19	12	21	06	06		40	21	35	24	34	17	35	12	37	54	19	18	12
19.	25	09	15	45	09	17	18	24	23	16	16	05	12	-02	08	-04	11	40		03	22	18	22	-07	36	06	19	40	22	-11	-08
20.	35	44	27	22	28	26	30	23	30	08	15	16	12	27	15	26	08	21	03		33	29	31	35	26	29	22	17	33	36	29
21.	32	40	23	37	25	21	26	22	41	13	14	10	27	27	19	26	13	35	22	-33		23	36	29	26	24	22	26	34	36	33
22.	20	21	15	21	18	38	22	22	21	03	13	13	16	22	14	16	14	24	18	29	23		17	20	22	13	18	12	18	29	21
23.	29	46	23	34	28	21	18	23	38	02	16	17	20	26	24	27	14	34	22	31	36	17		21	38	25	30	31	28	32	27
24.	29	41	39	11	32	19	32	24	28	-10	14	12	10	37	23	27	14	17	-07	35	29	20	21		26	39	30	-03	30	48	42
25.	31	38	37	45	18	23	34	19	45	08	16	08	10	27	26	21	05	35	36	26	26	22	38	26		27	36	36	26	25	19
26.	31	29	30	19	19	16	40	17	38	07	15	23	16	42	26	34	14	12	06	29	24	13	25	39	27		21	08	49	33	37
27.	34	43	29	21	35	16	22	24	31	12	15	18	29	15	29	09	09	37	19	22	22	18	30	30	36	21		26	13	21	18
28.	48	27	32	50	21	10	18	21	49	13	22	13	13	02	17	00	07	54	40	17	26	12	31	-03	36	08	26		17	07	01
29.	37	23	37	27	27	27	47	30	45	12	27	22	24	34	20	34	17	19	22	33	34	18	28	30	26	49	13	17		25	24
30.	21	40	28	13	31	20	32	12	32	04	13	15	17	38	26	35	33	18	-11	36	36	29	32	48	25	33	21	07	25		60
31.	20	36	27	09	19	16	13	21	21	04	11	25	26	40	20	39	12	12	-08	29	33	21	27	42	19	37	18	01	24	60	

Table 5

Correlation Matrix, Sample H, Boys and Girls, IQ 120+*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	32	33	36	37
1.		45	49	43	30	29	32	46	47	20	20	07	00	09	28	20	10	41	35	35	26	29	26	23	39	31	50	40	36	00	14	-09	30
2.	45		48	29	34	35	36	34	44	30	19	21	16	25	21	20	02	42	17	33	43	23	49	48	40	38	52	34	43	17	30	-13	29
3.	49	48		27	24	27	48	28	38	18	15	06	-03	22	28	16	-10	34	14	29	21	23	28	37	34	29	50	28	41	17	11	-11	17
4.	43	29	27		25	24	19	17	48	33	23	00	-14	-11	31	14	03	36	45	20	33	18	26	17	38	20	21	34	29	-15	01	-18	27
5.	30	34	24	25		12	19	24	26	23	09	16	05	00	27	-01	19	31	15	22	13	12	21	21	17	13	40	21	22	04	14	04	16
6.	29	35	27	24	12		21	37	34	36	22	09	-02	01	19	18	-02	25	12	08	19	43	20	26	20	29	20	14	20	05	14	-20	17
7.	32	36	48	19	19	21		30	38	20	17	11	10	19	19	19	-02	29	12	26	10	16	26	40	30	27	34	21	37	10	11	-26	11
8.	46	34	28	17	24	37	30		30	22	17	02	08	08	20	08	09	31	16	16	16	26	20	23	24	24	26	23	24	04	10	-22	19
9.	47	44	38	48	26	34	38	30		33	23	13	-04	03	36	21	02	36	31	35	28	24	26	28	30	29	33	44	42	02	12	-24	27
10.	20	30	18	33	23	36	20	22	33		19	17	07	10	14	06	28	25	16	18	20	21	30	19	21	13	12	11	23	01	05	-03	19
11.	20	19	15	23	09	22	17	17	23	19		03	-08	00	14	07	-03	20	05	16	19	11	29	17	27	22	20	11	22	-02	14	-16	26
12.	07	21	06	00	16	09	11	02	13	17	03		42	19	13	12	32	12	03	00	04	-02	08	12	09	06	12	17	06	00	08	-06	-07
13.	00	16	-03	-14	05	-02	10	08	-04	07	-08	42		24	-01	01	13	07	00	-01	05	-06	15	18	06	-05	-01	07	00	11	17	00	-04
14.	09	25	22	-11	00	01	19	08	03	10	00	19	24		10	17	08	20	-08	16	18	02	15	29	11	02	18	12	10	-03	43	-13	31
15.	28	21	28	31	27	19	19	20	36	14	14	13	-01	10		10	01	32	17	09	28	20	21	18	34	-03	24	28	16	-04	08	-10	04
16.	20	20	16	14	-01	18	19	08	21	06	07	12	01	17	10		02	15	15	07	14	10	17	08	13	17	09	10	18	13	16	-12	06
17.	10	02	-10	03	19	-02	-02	09	02	28	-03	32	13	08	01	02		08	17	07	-04	03	04	-05	05	-10	10	18	-06	-04	07	-03	20
18.	41	42	34	36	31	25	29	31	36	25	20	12	07	20	32	15	08		28	32	42	21	44	37	37	26	40	45	27	17	15	-20	03
19.	35	17	14	45	15	12	12	17	31	16	05	03	00	-08	17	15	17	28		02	21	13	19	01	38	-01	08	35	16	-20	-06	02	12
20.	35	33	29	20	22	08	26	16	35	18	16	00	-01	16	09	07	07	23	02		20	16	33	32	25	22	32	22	22	10	20	-15	19
21.	26	43	21	33	13	19	10	16	28	20	19	04	05	18	28	14	-04	42	21	20		16	39	23	49	15	17	33	25	09	12	-14	13
22.	29	23	23	18	12	43	16	26	24	21	11	-02	-06	02	20	10	03	21	13	16	16		13	08	18	13	19	16	21	03	06	-03	18
23.	26	49	28	26	21	20	26	20	26	30	29	08	15	15	21	17	04	44	19	33	39	13		34	43	21	25	15	24	08	21	-17	23
24.	23	48	37	17	21	26	40	23	28	19	17	12	18	29	18	08	-05	37	01	32	23	08	34		28	26	35	15	27	32	27	-19	11
25.	39	40	34	38	17	20	30	24	30	21	27	09	06	11	34	13	05	37	38	25	49	18	43	28		18	32	33	22	06	03	-18	24
26.	31	38	29	20	13	29	27	24	29	13	22	06	-05	02	-03	17	-10	26	-01	22	15	13	21	26	18		35	14	49	22	20	-15	42
27.	50	52	50	21	40	20	34	26	33	12	20	12	-01	18	24	09	10	40	08	32	17	19	25	34	32	35		32	31	17	18	-04	21
28.	40	34	28	34	21	14	21	23	44	11	11	17	07	12	28	10	18	45	35	22	33	16	15	15	33	14	32		17	02	05	-04	00
29.	36	43	41	29	22	20	37	24	42	23	22	06	00	10	16	18	-06	27	16	22	25	21	24	27	22	49	31	17		12	21	-10	35
32.	00	17	17	-16	04	05	10	04	02	01	-02	00	11	43	08	12	-04	17	-20	10	09	03	08	32	06	22	17	02	12		39	05	-03
33.	14	30	11	01	14	14	11	10	12	05	14	08	17	31	04	16	07	15	-06	20	12	06	21	27	03	20	18	05	21	39		-03	20
36.	-09	-13	-11	-18	04	-20	-26	-22	-24	-03	-16	-06	00	-03	-10	-12	20	-20	02	-15	-14	-03	-17	-19	-18	-15	-04	-04	-10	05	-03		05
37.	30	29	17	27	16	17	11	19	27	19	26	-07	-04	-13	-04	06	-03	03	12	19	13	18	23	11	24	42	21	00	35	-03	20	05	

* Decimal points have been omitted

Table 6

Unrotated Factor Matrix, Sample T, Boys and Girls, Full Range IQ *

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	h^2
1.	60	-14	31	04	14	-10	04	14	16	02	02	06	10	07	08	00	03	02	.58
2.	76	10	16	08	14	15	03	01	-10	-06	14	01	-05	03	-02	03	07	02	.71
3.	63	07	-08	22	17	-10	04	-10	-07	06	-14	02	-05	05	-03	-02	-04	-05	.55
4.	60	-46	00	-13	-08	-03	10	11	-11	-02	00	-06	-12	-01	06	07	-04	00	.66
5.	56	05	12	07	12	03	07	-18	02	-03	21	00	-05	01	-03	-06	-05	-01	.44
6.	50	-14	24	32	-12	12	-16	11	-19	11	03	00	-05	-03	00	-02	02	02	.55
7.	65	06	-13	-05	02	-28	01	-20	01	14	-04	-10	-09	01	03	01	01	04	.60
8.	34	-16	36	25	-19	-01	-10	-04	19	11	-05	06	05	00	-01	01	-02	00	.44
9.	75	-24	-07	-06	-11	-12	-01	05	-05	13	06	-10	02	-01	-10	-04	02	02	.70
10.	26	10	14	-44	15	06	-25	13	01	-02	-05	03	01	-08	-04	00	00	-01	.41
11.	33	-12	-08	23	-25	-04	-13	04	06	-13	03	-12	-05	01	01	01	02	-05	.31
12.	31	38	17	-46	-01	-09	-13	-10	-01	06	00	07	-01	03	-01	01	01	00	.53
13.	43	36	28	-06	-18	00	12	-08	-14	-02	-04	13	-04	-05	00	-01	07	-04	.50
14.	65	46	-06	07	-06	04	07	09	08	02	-06	-13	00	-07	06	-06	00	00	.70
15.	55	15	22	-26	13	01	-03	12	-04	-02	05	-20	05	03	-01	01	-04	-02	.52
16.	54	21	-03	-25	-29	06	14	00	02	-04	-02	04	-02	10	01	-04	-05	01	.53
17.	27	29	40	00	-30	-06	14	-02	08	04	03	-05	05	-04	00	06	-01	-01	.45
18.	70	-19	09	03	04	03	-06	-05	-02	-12	-09	00	13	-13	00	-04	-04	00	.60
19.	26	-57	15	-21	09	09	17	-16	-04	-07	00	-04	-03	-08	05	01	00	00	.41
20.	50	13	-04	09	11	05	00	19	20	04	04	05	-19	-03	-05	00	-03	00	.55
21.	66	-12	-17	-07	-01	16	13	12	-12	10	07	08	09	07	05	-05	00	-02	.59
22.	32	-19	25	-01	00	12	-29	-12	-04	00	-10	01	-08	08	10	-03	-01	01	.35
23.	70	-04	-10	02	-05	20	-07	-04	02	-06	-09	13	-05	-05	-08	04	-03	03	.59
24.	67	20	-15	11	11	11	01	02	-09	05	-19	-05	07	08	-04	09	00	-01	.62
25.	60	-11	-19	-07	11	20	-01	-10	28	07	06	05	02	-01	05	04	03	-02	.57
26.	54	07	-25	11	-11	-17	-11	05	-11	-03	10	15	10	-04	05	04	-05	01	.49
27.	48	03	33	20	14	-06	-01	-13	01	-19	04	-03	09	06	-08	01	01	01	.42
28.	56	-36	03	-05	10	-24	16	13	06	-05	-14	06	00	00	-03	-05	05	00	.59
29.	69	-01	-26	04	04	-27	-14	-03	-01	-02	10	09	-02	-03	01	03	01	-03	.66
34.	49	-03	-32	-13	-24	04	-10	00	09	-25	-03	-03	-02	07	00	-01	03	02	.51
35.	51	44	-29	15	13	05	-01	-05	-01	00	-01	-07	03	-08	08	-01	02	02	.61
36.	-26	36	26	15	17	-14	06	11	-03	-18	-03	05	-09	01	07	01	-02	01	.40

Table 7

Unrotated Factor Matrix, Sample B, Boys, IQ 95-119 *

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	h^2
1.	65	-23	-19	09	01	18	18	04	-04	-17	10	03	09	02	04	05	00	64
2.	67	13	01	13	-13	-16	09	09	-07	-06	-06	-08	05	-05	05	-09	01	58
3.	59	01	09	04	24	12	16	09	-15	-03	09	-14	08	-04	-01	04	-02	52
4.	57	-35	04	-25	-14	-07	-24	05	-07	-07	-05	-01	06	-07	-01	03	-05	63
5.	54	07	01	06	-22	-26	14	-11	07	-02	-06	-08	08	00	-08	01	07	48
6.	45	-03	-16	39	-06	08	-15	-11	-05	10	02	-07	10	-01	06	00	-04	46
7.	58	-07	29	12	19	-01	-03	03	-02	03	-03	01	-10	-14	-02	-03	03	51
8.	52	-15	-22	36	15	00	05	05	00	02	04	13	-10	04	-04	05	03	54
9.	67	-14	15	-22	05	09	00	-03	05	08	-13	15	05	08	01	-06	00	62
10.	33	-05	02	12	04	-09	-05	02	32	-15	12	10	-04	-04	-02	02	-03	29
11.	35	-11	00	07	18	-04	-19	14	14	13	04	-02	00	00	15	-03	03	29
12.	27	26	-60	-18	16	-10	05	-02	-09	13	-01	03	-01	02	00	00	-02	60
13.	29	12	-57	-18	11	-15	-08	-05	-05	11	02	-01	-04	-10	-03	04	01	53
14.	43	41	-04	-09	-02	15	-09	-03	-05	-16	-01	-04	-10	08	02	-03	-03	44
15.	39	06	-13	-15	16	25	08	08	12	-07	-05	-11	-03	-09	-04	-06	03	34
16.	30	20	-16	-11	-01	-03	-26	-14	18	-15	02	-11	04	05	01	03	05	33
17.	26	02	-42	12	00	02	05	11	08	-16	-20	09	03	02	01	-01	-02	36
18.	63	-23	-03	-20	-21	10	02	-18	03	07	12	-01	-06	04	08	03	03	62
19.	41	-47	-06	-09	-13	-02	-17	24	00	05	-02	-06	-05	09	-08	-03	00	53
20.	53	12	18	-07	-02	-07	05	-25	-15	-12	-01	08	-11	-06	04	-03	-02	46
21.	54	00	-03	-10	03	17	-15	01	-19	-06	14	08	02	02	-05	-07	05	43
22.	43	-02	-11	37	-15	05	-14	-15	-04	06	-08	04	00	01	-05	-07	-01	42
23.	57	21	16	01	-12	-20	-09	11	-09	01	16	09	05	-01	-04	04	00	52
24.	55	28	13	-16	06	-23	12	12	00	-01	-02	11	06	04	06	-01	01	53
25.	60	-05	11	02	-11	00	-05	09	-11	-03	-18	-06	-12	01	03	12	01	48
26.	45	11	27	06	30	-01	04	-07	-04	05	-08	-06	-02	15	-01	05	02	43
27.	53	-11	-07	03	-16	-15	26	05	09	04	10	-12	-12	05	01	-06	-03	48
28.	55	-40	-02	-16	-03	12	22	-15	11	10	-04	04	05	-05	-02	03	-02	62
29.	56	-04	21	-02	37	-13	-12	-12	11	01	00	-06	02	01	-06	-01	-05	56
30.	31	43	17	01	-18	19	-04	08	10	12	-06	04	01	-10	01	05	01	60
31.	35	56	06	00	-18	18	03	08	11	13	06	01	00	05	-06	00	-04	55

Table 8

Unrotated Factor Matrix, Sample G, Girls, IQ 95-119 *

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	h^2
1.	-64	-25	17	-12	-25	-09	14	16	-02	-02	-01	-01	-05	-03	-09	00	-02	.65
2.	-65	10	05	28	-05	-03	-03	-03	-07	-11	-18	-05	05	-06	-03	-02	03	.58
3.	-58	-07	22	-14	-14	-18	05	00	-02	13	07	-11	03	-06	11	-03	00	.52
4.	-55	-43	00	02	21	11	04	09	-09	00	00	01	02	02	-05	-09	00	.57
5.	-46	02	15	02	-21	-04	01	-08	20	-10	-02	07	-04	07	10	02	-01	.36
6.	-47	01	-21	-15	-21	34	-16	01	-10	-03	-01	-01	00	-02	05	01	00	.49
7.	-53	01	08	-31	11	00	-12	-18	13	-17	06	-04	-01	02	-01	-03	02	.50
8.	-49	-11	-01	-16	-34	13	13	02	-09	09	-02	09	02	-08	02	03	02	.46
9.	-73	-20	03	-10	08	-04	-14	18	-12	-12	01	00	10	03	05	02	00	.69
10.	-17	-10	-26	-03	13	-04	-11	00	17	-04	06	-08	05	-19	02	06	00	.21
11.	-34	-13	-11	-13	04	00	-25	16	12	15	-09	08	-07	01	-01	-06	01	.31
12.	-38	17	-47	02	-20	-17	01	06	-02	-03	-01	-10	-07	07	-04	00	03	.48
13.	-41	17	-58	08	-08	-05	04	-03	03	-11	09	09	-01	00	00	-06	-01	.58
14.	-51	36	-03	-08	03	02	16	-05	-22	-16	10	-02	03	02	00	01	-01	.51
15.	-42	03	-08	05	02	-07	-31	06	-14	09	01	05	06	03	-03	06	-02	.33
16.	-42	38	-20	02	21	02	10	04	00	07	-07	01	-09	-06	06	-09	-03	.46
17.	-22	10	-30	02	03	-11	07	-11	03	22	-08	-13	15	07	03	02	00	.27
18.	-54	-40	02	16	-04	00	04	-02	11	01	12	00	02	03	-03	-02	-01	.51
19.	-31	-52	-16	-03	12	10	12	-21	02	12	06	06	-03	-01	-04	04	02	.50
20.	-51	16	13	03	-03	13	03	01	12	-05	-21	-14	-04	-05	-05	02	-01	.41
21.	-57	01	01	13	15	14	14	05	14	-04	00	09	18	-02	-02	00	00	.46
22.	-38	04	-05	02	-08	35	-03	-11	05	09	04	-13	-03	08	-04	02	-02	.33
23.	-57	-04	00	24	12	02	09	00	-06	00	-17	10	-06	07	07	08	01	.46
24.	-52	36	31	01	-11	-06	-06	-11	00	12	-01	03	09	04	-04	-10	01	.56
25.	-56	-20	12	10	20	00	-07	-20	-20	02	03	-05	-11	-05	05	-03	00	.52
26.	-51	25	07	-26	20	-19	01	-04	-05	00	01	03	-04	02	-10	07	-01	.49
27.	-49	-11	02	25	-18	-20	-15	-23	02	-01	00	09	-02	-06	-03	02	-02	.47
28.	-48	-56	-01	12	06	-14	08	16	05	-02	04	-11	-04	06	03	01	-01	.63
29.	-57	08	-04	-41	14	-05	09	-02	11	01	-06	08	-01	01	03	02	00	.56
30.	-54	42	22	17	10	11	-10	11	12	00	15	-02	-05	03	03	02	01	.64
31.	-49	47	05	16	03	02	09	15	01	15	15	02	-05	-06	-03	04	02	.58

* Decimal points have been omitted

Table 9

Unrotated Factor Matrix, Sample H, Boys and Girls, IQ 120+ *

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	h^2
1.	-68	18	01	-11	-24	00	02	07	-15	-01	-15	-05	-01	-05	-03	-02	-06	-00	-05	.64
2.	-73	-18	-01	-06	05	-07	-04	-02	-11	00	19	01	-18	09	-09	01	-04	01	05	.68
3.	-61	-08	13	09	-28	07	-04	-03	-03	23	04	00	00	06	-03	-00	-01	02	-02	.57
4.	-53	45	00	05	06	-07	-02	04	10	00	03	04	00	-05	-03	07	-07	00	-04	.57
5.	-42	02	012	-24	-16	-07	00	-22	08	-06	13	02	-02	-13	-04	-04	00	-03	01	.39
6.	-46	07	17	-06	21	38	26	-02	-07	-02	05	00	-02	04	-05	10	00	01	00	.55
7.	-52	-12	06	07	-10	22	-23	-01	02	16	-07	06	07	-03	03	-01	06	00	02	.48
8.	-48	04	02	-08	-02	24	08	-06	-22	-10	-12	06	01	-12	09	-07	-05	00	03	.44
9.	-65	20	03	06	-04	13	-06	12	25	-04	-02	-07	-12	-01	06	01	02	00	03	.61
10.	-42	09	-14	-24	29	11	09	-15	18	14	00	11	03	09	06	-01	-05	00	00	.48
11.	-34	08	16	01	19	-04	-02	-09	03	-07	-01	-15	17	-02	-02	00	00	09	00	.28
12.	-18	-20	-43	-23	11	18	-23	10	00	03	15	-13	04	05	-01	01	00	-01	-02	.48
13.	-08	-34	-31	-12	18	05	-10	06	-17	00	03	01	-11	-10	06	00	03	00	-04	.38
14.	-23	-54	-22	11	-02	00	11	09	02	11	-10	-02	02	03	03	-03	-06	02	00	.46
15.	-41	11	-21	20	-10	07	13	-08	10	05	17	-17	02	-15	02	-04	01	-02	00	.42
16.	-26	-06	-02	05	07	08	02	30	04	06	-08	-07	06	01	-18	-02	00	-03	01	.24
17.	-08	02	-45	-42	01	-03	05	-02	06	-01	-14	00	13	05	00	00	00	-01	02	.45
18.	-63	-01	-21	17	-02	-03	08	-03	00	-20	03	19	09	00	-05	-05	04	01	-03	.59
19.	-34	44	-28	00	00	-10	-01	21	-06	11	-06	14	00	-10	-05	06	02	01	01	.52
20.	-45	-09	06	-01	-06	-13	-08	-17	13	-03	-27	-07	-10	09	02	-01	04	-03	-02	.41
21.	-49	05	-12	28	20	-23	12	05	-05	-05	08	-02	-07	10	06	-08	-04	-01	00	.51
22.	-36	13	10	-07	02	17	32	-02	-08	06	-02	-05	-06	06	00	-02	10	-01	-02	.34
23.	-55	-06	-06	10	30	-19	106	-17	-04	04	-06	03	01	00	-12	-07	06	00	00	.53
24.	-52	-35	02	12	04	03	-08	-15	04	03	01	11	-05	-06	03	14	00	00	-01	.50
25.	-58	14	-09	22	11	-18	-03	-02	-18	12	00	-09	12	00	10	08	00	-04	01	.57
26.	-47	-12	41	-15	03	-03	-08	17	-02	-17	09	07	11	09	02	01	01	-04	-01	.55
27.	-60	-13	06	-12	-35	-07	-02	-15	-07	-06	07	-07	08	06	-08	05	-01	00	01	.60
28.	-49	15	-32	06	-22	-04	01	17	00	-18	-02	00	-05	10	10	03	04	04	01	.52
29.	-55	-03	27	-11	-01	-04	-08	18	09	09	12	06	01	-01	06	-15	00	01	00	.51
32.	-17	-58	07	08	-06	-08	26	10	09	00	02	05	07	-06	07	05	00	-03	00	.51
33.	-28	-41	07	-12	10	-13	13	11	08	-08	-10	-07	-05	-16	-06	01	00	03	00	.41
36.	24	00	-09	-33	-16	-29	21	02	-02	17	09	03	-01	02	02	01	04	03	00	.38
37.	-36	13	40	-32	16	-24	-03	04	-08	04	00	-07	-02	-07	06	03	01	00	00	.52

Table 10

Rotated Factor Matrix, Sample T, Boys and Girls, Full Range IQ [a]

	DMU	DSU	DMC	DMR	DMS	DSS	DMT	DFT	DFI	DMI	EMI	CMU	Sd	Fm	R_1	R_2	Q_o	R_o	h^2
1.	20	12	34	15	27	02	37	23	19	12	16	03	-05	-07	15	-10	03	02	.57
2.	04	21	45	22	20	04	25	22	08	19	34	27	04	-01	-18	00	07	02	.72
3.	08	21	14	45	31	-06	17	05	03	15	18	28	02	-02	-01	12	-04	-05	.56
4.	53	07	20	11	33	09	00	01	20	19	31	-01	06	09	-13	-06	-04	00	.66
5.	14	16	32	06	33	-05	18	17	04	16	18	24	02	03	-04	12	-05	-01	.46
6.	07	14	22	26	04	02	18	08	51	09	24	08	-04	02	-18	05	02	02	.55
7.	23	23	08	26	47	05	05	16	00	10	03	35	00	06	02	13	01	04	.59
8.	05	02	10	14	14	-12	26	25	47	10	03	-09	03	08	08	02	-02	00	.45
9.	46	29	17	19	27	12	14	11	19	20	23	18	00	13	-03	09	02	02	.67
10.	00	05	13	00	09	48	04	27	-11	19	07	-04	-11	-02	00	-06	00	-01	.40
11.	15	16	06	11	08	01	07	-04	32	07	01	13	31	01	-03	00	02	-05	.30
12.	-08	13	08	00	20	32	-06	54	-18	02	01	13	-09	03	00	06	01	00	.53
13.	-04	12	12	13	09	-06	-03	56	07	09	14	23	00	-12	-15	06	07	-04	.51
14.	06	12	12	27	06	09	21	34	00	15	11	61	15	00	-01	00	00	00	.71
15.	15	08	43	12	12	29	08	32	-04	13	11	21	-07	03	02	-03	-04	-02	.52
16.	20	12	04	06	12	09	-01	47	-06	06	28	27	22	01	-04	04	-05	01	.52
17.	04	00	16	01	-02	-14	04	58	19	00	-08	18	02	01	-02	-01	-01	-01	.46
18.	18	20	25	21	27	08	11	12	23	43	26	11	06	04	08	-01	-04	00	.62
19.	30	-15	24	-11	33	-05	-10	-08	09	30	26	-24	-08	10	-02	00	00	00	.55
20.	11	08	10	18	15	12	44	12	-02	12	10	24	12	-03	-14	-02	-03	00	.42
21.	29	22	12	14	15	07	15	08	01	14	54	23	00	05	-04	-05	00	-02	.59
22.	-08	-04	17	14	26	21	02	10	32	10	19	-13	03	06	00	07	-01	01	.35
23.	14	16	08	25	22	00	18	18	03	35	38	17	19	12	-14	-02	-03	03	.60
24.	04	18	16	50	13	06	14	13	-06	17	28	35	08	01	-01	-05	00	-01	.61
25.	09	05	08	05	36	10	34	04	-06	27	30	18	13	29	01	-06	03	-02	.58
26.	12	51	-03	15	19	05	08	06	12	08	18	29	10	04	-03	-09	-05	01	.51
27.	-05	22	40	20	20	-12	14	13	11	18	06	08	10	-04	07	06	01	01	.42
28.	50	15	14	20	34	00	16	04	06	22	18	-06	02	-11	11	-01	05	00	.59
29.	22	49	05	17	42	17	14	04	01	16	13	27	09	09	-02	00	01	-03	.68
34.	20	23	-01	07	17	20	-02	08	-01	17	20	19	46	08	01	-02	03	02	.50
35.	-15	20	05	27	10	06	15	06	-12	16	13	60	10	05	-03	-02	02	02	.61
36. [a]	24	07	-11	-02	11	10	-01	-09	07	17	24	-04	02	45	03	05	-02	01	.41

[a] This variate has been reflected for easier interpretation.

Table 11

Rotated Factor Matrix, Sample B, Boys, IQ 95-119 *

	DMU	DSU	DMC	DMR	DMS	DSS	DMT	DFT	DFI	DMI	EMI	CMU	FS	Sp	R_1	P_o	Q_o	h^2
1.	28	07	29	37	11	10	15	33	27	23	15	-02	13	02	14	05	00	.65
2.	04	08	32	13	25	-02	27	13	25	12	24	27	28	07	-08	-09	01	.59
3.	11	29	22	38	27	-04	03	16	05	21	25	14	08	09	04	04	-02	.54
4.	52	06	12	04	14	14	27	-01	07	36	13	01	22	05	-20	03	-05	.65
5.	10	13	42	-02	08	00	36	05	20	-04	20	17	19	06	-04	01	07	.50
6.	06	16	19	15	10	04	-02	08	58	05	09	04	16	14	-06	00	-04	.51
7.	09	28	17	10	48	09	12	-07	11	27	21	08	08	03	06	-03	03	.53
8.	02	14	21	08	22	06	07	24	40	24	07	-10	15	17	26	05	03	.54
9.	50	20	07	06	28	11	24	07	06	16	29	18	11	04	16	-06	00	.64
10.	-02	10	23	-05	10	37	10	07	09	10	08	-01	17	03	15	02	-03	.31
11.	13	15	01	04	22	19	-10	-02	12	14	07	00	32	16	05	-03	03	.31
12.	05	-02	01	-01	-02	-02	07	51	05	-09	03	14	07	55	-04	00	-02	.61
13.	11	-02	07	-06	01	08	08	41	08	-01	-02	04	07	55	-15	04	01	.54
14.	-04	11	-04	17	05	17	22	17	11	09	09	48	-02	13	-03	-03	-04	.43
15.	19	16	14	18	18	17	-04	31	-03	06	-03	22	-02	06	01	-06	03	.34
16.	04	17	00	-01	-11	35	16	12	11	-02	02	23	10	16	-16	03	05	.34
17.	04	-03	07	-05	04	07	08	49	25	02	-06	03	16	01	02	00	-02	.36
18.	52	01	24	24	10	16	30	-05	18	10	07	12	07	19	08	03	03	.62
19.	47	03	17	-01	04	01	06	-01	12	41	-10	-05	29	03	00	-03	-01	.54
20.	06	12	09	16	26	08	47	-02	08	08	26	17	-06	11	00	-03	-02	.47
21.	24	08	03	23	07	12	13	12	14	35	23	18	-02	18	-01	-07	05	.44
22.	06	11	14	-02	10	04	14	03	57	12	09	05	01	07	00	-07	00	.43
23.	-04	04	21	10	-02	08	19	-03	08	15	49	24	07	17	06	04	00	.47
24.	02	09	14	03	22	03	26	13	-10	05	40	33	28	14	08	-01	01	.55
25.	22	11	12	09	32	-03	28	03	20	26	07	25	18	00	-04	12	00	.49
26.	03	46	-01	13	26	-04	13	-02	04	06	24	17	10	06	14	05	02	.44
27.	16	03	45	15	13	-02	25	05	12	06	-01	12	26	15	16	-06	-03	.49
28.	58	12	31	16	22	07	18	09	09	01	10	-09	02	03	16	02	-02	.62
29.	12	51	09	04	29	20	15	-02	00	15	24	02	14	17	04	-01	-03	.56
30.	05	02	14	03	26	15	02	-01	20	02	26	60	-01	01	01	05	01	.58
31.	-07	00	15	04	04	09	-03	04	14	-04	21	65	-05	10	09	00	-04	.58

* Decimal points have been omitted.

Table 12

Rotated Factor Matrix, Sample G, Girls, IQ 95-119 *

	DMU	DSU	DMC	DMR	DMS	DMT	DFT	DFI	DMI	EMI	CMU	FS	Sp	R_1	R_2	P_o	Q_o	h^2
1.	35	18	23	23	05	31	-09	25	37	08	08	05	14	-10	-14	00	-02	.65
2.	20	-11	33	04	23	31	19	06	20	28	21	08	11	-11	14	-02	03	.58
3.	18	17	14	42	18	13	03	15	28	25	07	01	10	-08	-10	-03	00	.52
4.	52	14	07	-04	19	07	-01	09	38	04	05	16	-05	09	08	-09	00	.57
5.	-07	11	23	05	04	22	00	16	25	30	05	05	10	-09	-08	02	-01	.36
6.	08	-01	-02	07	14	14	07	44	11	-04	24	34	11	-03	17	01	00	.49
7.	-02	42	07	03	36	09	09	13	22	12	11	20	04	-13	-02	-03	02	.50
8.	16	09	14	27	-08	21	-04	39	25	02	12	12	09	-02	12	03	02	.46
9.	47	18	06	11	25	14	06	10	29	18	22	29	10	-18	00	02	00	.69
10.	04	02	00	-02	14	-08	21	-07	17	-14	-11	19	16	-05	03	06	00	.21
11.	18	10	-01	12	10	16	03	-03	08	-04	04	40	12	12	-07	-06	01	.31
12.	11	-01	21	04	-03	07	44	23	-06	-04	15	14	34	-03	-08	00	03	.48
13.	06	02	25	-10	-10	05	48	16	03	-04	15	24	33	-02	16	-06	-01	.58
14.	04	16	17	06	14	00	22	19	10	16	48	-10	10	-16	14	01	-01	.51
15.	24	-03	16	17	19	06	12	00	-05	09	18	33	03	-05	03	06	-02	.33
16.	-04	07	10	04	10	05	34	-08	11	08	41	04	22	15	15	09	-03	.46
17.	05	02	05	15	-02	02	47	05	00	04	-02	05	02	11	06	02	00	.27
18.	34	02	28	01	13	06	02	16	42	12	-11	19	-02	03	-08	-02	-01	.51
19.	34	20	14	-04	07	-08	03	20	32	-06	-26	15	-08	23	15	04	02	.50
20.	-03	02	09	02	25	40	12	08	25	15	22	02	09	00	04	02	-01	.41
21.	13	04	18	-04	07	14	18	-02	46	12	25	15	-08	-02	10	00	00	.46
22.	-04	-06	05	00	20	12	11	34	19	04	18	16	-10	15	05	02	-02	.33
23.	28	01	24	-05	09	18	12	00	23	30	19	10	08	14	16	08	01	.46
24.	-12	08	28	32	19	25	08	04	08	31	33	05	-10	-08	-01	-10	01	.56
25.	33	11	22	07	41	-02	-01	09	19	24	05	07	01	11	18	-03	00	.52
26.	05	40	17	18	24	10	18	-06	05	10	34	01	08	-04	-01	08	-01	.49
27.	14	-03	49	11	17	13	07	08	10	23	-12	20	08	-08	06	02	-02	.47
28.	57	05	13	-03	10	05	02	08	40	12	-18	11	10	06	-17	01	-01	.63
29.	05	51	02	15	10	16	18	06	26	07	23	16	14	02	04	02	00	.56
30.	-14	-09	20	07	28	08	08	-07	25	27	53	13	02	00	-12	02	01	.64
31.	-08	-11	28	22	11	05	19	-05	19	12	55	00	09	07	-05	04	02	.58

Table 13

Rotated Factor Matrix, Sample H, Boys and Girls, IQ 120+ *

	DMU	DSU	DMC	DMR	DMS	DSS	DMT	DFT	DFI	DMI	EMI	CMU	FS	R_1	R_2	P_o	Q_o	R_o	S_o	h^2
1.	32	06	41	04	28	00	31	05	27	22	08	-07	14	16	-01	-03	-07	00	-05	.63
2.	14	23	38	35	16	12	10	12	20	32	29	-06	13	-10	09	01	-05	01	06	.67
3.	10	16	36	38	34	14	24	-04	15	12	00	-06	-04	13	-01	-01	-02	03	-03	.57
4.	46	14	09	01	19	16	02	-01	01	32	-01	-22	19	14	-20	08	-07	-01	-05	.55
5.	22	00	42	04	09	21	-02	-01	02	06	24	10	05	04	-16	-05	00	-03	02	.39
6.	08	17	01	11	07	25	-03	-07	58	24	06	-01	13	08	-04	10	01	01	00	.54
7.	08	16	11	28	44	18	23	15	17	-02	06	-08	-01	04	-04	-01	06	01	03	.47
8.	07	-01	16	01	25	03	15	11	46	14	13	04	14	05	-14	-08	-06	-01	03	.42
9.	43	23	19	07	28	28	17	05	19	19	-08	-13	17	-08	-08	02	02	00	03	.60
10.	13	14	02	10	-13	40	05	26	19	17	16	-08	14	11	-22	-02	-05	00	00	.47
11.	01	22	06	-01	20	13	-07	01	07	11	06	-06	34	14	-03	00	00	09	00	.27
12.	07	14	14	-06	03	18	-12	53	10	00	12	01	-17	-12	20	01	00	-01	-14	.48
13.	-06	-05	03	14	01	-05	-07	48	09	-02	19	06	-02	-23	16	00	04	00	-04	.38
14.	-14	09	05	30	07	09	25	27	-01	13	00	33	-04	-10	22	04	-07	03	-01	.45
15.	18	-05	22	09	27	25	-11	10	04	33	-18	12	00	10	-05	-05	02	-02	00	.42
16.	20	18	-10	10	11	05	12	09	12	13	-02	04	00	09	27	-02	00	-03	02	.24
17.	11	-03	14	-25	-25	16	16	43	-01	02	17	10	-04	13	-02	00	-01	-02	02	.45
18.	18	19	15	08	32	09	12	12	06	49	22	18	01	00	-16	-05	04	01	-03	.58
19.	46	-08	03	-02	06	-10	11	23	01	33	01	-19	-01	21	-12	06	02	01	02	.50
20.	02	10	24	08	18	24	35	-01	-07	11	13	-06	28	-10	01	-01	04	-04	-02	.41
21.	07	17	11	18	11	-01	-02	10	-03	59	-02	-04	22	-05	-02	-08	-04	-02	00	.50
22.	07	03	15	08	-04	15	10	-09	39	23	-05	-01	12	15	-05	-03	11	-01	-03	.32
23.	06	13	13	20	08	17	04	21	01	27	40	-09	32	10	02	-07	06	01	00	.52
24.	-04	15	14	39	32	20	11	11	07	13	22	13	12	-14	-05	15	00	01	-01	.48
25.	04	11	20	17	30	-02	04	22	00	45	-02	-16	24	21	-05	08	01	-05	02	.56
26.	12	54	17	14	16	-10	07	-10	23	-05	18	00	22	-01	-02	02	02	-04	-01	.54
27.	06	22	57	12	29	11	18	-04	09	10	20	09	02	11	01	05	-01	00	01	.60
28.	28	13	30	-11	19	-01	23	20	04	40	-07	02	-07	-10	-08	04	05	05	01	.52
29.	29	39	20	32	16	02	09	00	16	-01	04	-06	18	03	-06	-16	01	01	00	.49
32.	-13	20	05	25	02	00	15	01	00	01	-02	52	08	-09	10	01	04	03	00	.50
33.	08	14	07	22	00	05	11	06	06	-01	16	35	31	-11	24	06	01	-04	01	.41
36.[a]	03	10	-21	-02	48	-13	02	-02	-14	-12	-02	12	-07	-15	-03	-02	00	-03	-01	.37
37.	19	22	22	14	-06	-09	-01	-07	16	-09	13	20	49	15	-04	03	01	00	-01	.53

[a] This variate has been reflected for easier interpretation.
* Decimal points have been omitted.

Ideational Fluency DMU

Sample T

4.	Consequences (obvious)	.53 (DMS .33, EMI? .31)
28.	Utility Test (fluency)	.50 (DMS .34)
9.	Ideational Fluency	.46
19.	Plot Titles (low)	.30 (DMS .33, DMI .30)

Sample B

28.	Utility Test (fluency)	.58 (DMC .31)
18.	Planning Elaboration II	.52 (DMT .30)
4.	Consequences (obvious)	.52 (DMI .36)
9.	Ideational Fluency	.50
19.	Plot Titles (low)	.47 (DMI .41)

Sample G

28.	Utility Test (fluency)	.57 (DMI .40)
4.	Consequences (obvious)	.52 (DMI .38)
9.	Ideational Fluency	.47
1.	Alternate Signs	.35 (DMI .37, DMT .31)
18.	Planning Elaboration II	.34 (DMI .42)
19.	Plot Titles (low)	.34 (DMI .32)
25.	Simile Interpretation	.33 (DMS .41)

Sample H

4.	Consequences (obvious)	.46 (DMI .32)
19.	Plot Titles (low)	.46 (DMI .33)
9.	Ideational Fluency	.43
1.	Alternate Signs	.32 (DMT .31, DMC .41)

Ideational Fluency, used as a marker test for divergent production of semantic units, is the only factorially unique measure common to the results from all four samples, and thus is the primary basis for the identification of this factor. Consequences (obvious), Plot Titles (low), and Utility Test (fluency) all have a history of loadings on this dimension. With the exception of sample H, in which Utility Test (fluency) does not appear on this factor, all help determine the appropriate identification of this dimension.

Of especial interest is the clear indication that ideational fluency—the ability to think rapidly of many ideas appropriate to a situation—is unrelated to verbal comprehension, as shown by the absence of verbal-comprehension tests from these lists. Since such tests dominate measures of the IQ, this result shows the futility of trying to select students high in ideational-fluency ability using only measures of the IQ. As we shall see, verbal comprehension is distinct from almost all the divergent-production abilities. It should be noted that the obtained differentiation between verbal comprehension and ideational fluency means only that individual differences in the one factor do not correlate with those in the other. It should be understood that a minimal level of verbal comprehension is required to perform on the Ideational Fluency test. Our findings indicate that almost all examinees had at least that much verbal-comprehension ability.

The presence of Planning Elaboration II in the lists of tests for samples B and G, is rather disappointing. We had hypothesized that test to be a measure of factor DMI elaboration. The reason probably is that in working out the details of plans the examinees tended to make extensive lists of specific objects as in an ideational-fluency test, rather than giving the adult type of responses listing activities and broad categories of necessary objects. This ninth-grade tendency made the test very similar to those designed for ideational fluency. It is of note that in sample H the test differentiated in a way similar to its performance with adult samples. Such results indicate that the examinee's own strategy in taking a test helps to determine the test's factor content, where the instructions and the items do not control his procedures sufficiently. Complete control is difficult to achieve, especially in divergent-production tests, where much freedom must be permitted.

Word Fluency DSU

Sample T

26.	Suffixes	.51	
29.	Word Fluency	.49	(DMS .42)

Sample B

29.	Word Fluency	.51	
26.	Suffixes	.46	

Sample G

29.	Word Fluency	.51	
7.	Expressional Fluency	.42	(DMS .36)
26.	Suffixes	.40	(CMU .34)

Sample H

26.	Suffixes	.54	
29.	Word Fluency	.39	(DMR .32)

The results clearly substantiate the expectation of differentiation of ninth-grade students in terms of factor DSU—word fluency. This factor is the same as the one originally isolated by Thurstone in his study of primary mental abilities, in which he also used a test like our Suffixes. The factor is the ability to produce words rapidly in response to some specification having to do with letter composition; meaning is of no consequence.

The significant loading of Word Fluency on the factor of expressional fluency in sample T and the significant loading of Expressional Fluency on the factor of word fluency in sample G may be due to a common feature of those two tests that is somewhat incidental. Both involve the giving of words in response to a single letter. Suffixes does not have this property and does not show variance in expressional fluency. It is possible that an expressional fluency test, such as Simile Interpretation, which does not present initial letters, will generally not show variance in word fluency. It is also possible that items presenting syllables rather than single letters will prove to be better measures of word fluency. Suffixes and Word Fluency, however, have exactly the same average loading in the factor in these four analyses.

Spontaneous Flexibility DMC

Sample T

2.	Alternate Uses	.45	(EMI? .34)
15.	Multiple Grouping	.43	(DFT .32)
27.	Utility Test (shifts)	.40	
1.	Alternate Signs	.34	(DMT .37)
5.	Consequences (remote)	.32	(DMS .33)

Sample B

27.	Utility Test (shifts)	.45	
5.	Consequences (remote)	.42	(DMT .36)
2.	Alternate Uses	.32	
28.	Utility Test (fluency)	.31	(DMU .58)

Sample G

27.	Utility Test (shifts)	.49	
2.	Alternate Uses	.33	(DMT .31)

Sample H

27.	Utility Tests (shifts)	.57	
5.	Consequences (remote)	.42	
1.	Alternate Signs	.41	(DMU .32; DMT .31)
2.	Alternate Uses	.38	(DMR .35; DMI .32)
3.	Associational Fluency	.36	(DMS .34; DMR .38)
28.	Utility Test (fluency)	.30	(DMI .40)

In the history of theory of "creativity," few concepts have served so well to differentiate creative thinking from ordinary thinking as the notion of set, or rather set-breaking. Flexibility in thinking was investigated in the initial study of creativity by the Aptitudes Research Project (26). A single factor was originally hypothesized but two were found: spontaneous flexibility, the degree to which the examinee changes set without instruction, and adaptive flexibility, the degree to which the examinee, when forced by the nature of the problem, changes set in order to obtain more than one acceptable solution. The distinction between these two flexibility factors has been elaborated upon in a previous report (11).

Placing the factor of spontaneous flexibility in the cell DMC in the structure of intellect calls for explanation. The factor has been consistently determined by the "shift" score of the test, Brick Uses, and the score for the test, Unusual Uses. The shift score in Brick Uses is the number of times the examinee, in listing uses for a common brick, jumps from one category of uses to another—in other words, the number of times he goes from one class to another. This activity is regarded as a divergent production of classes, hence factor DMC. In Unusual Uses, the examinee is practically forced to go from one class of uses to another by the nature of the items. Brick Uses is one part of the Utility Test, and Unusual Uses has become, by minor revision, Alternate Uses. These two tests appear in all four lists for the factor in this study.

It had been concluded that tests of adaptive flexibility call for transformations, revisions, or redefinitions. In the use of verbal or semantic information, the factor is DMT in the structure of intellect. It will be noted that one test in each list above shows a secondary loading in factor DMT. This may mean that the two flexibility factors are not fully separable in the ninth-grade samples, but it is more likely to mean that in constructing tests we are unable to isolate the two kinds of products. A change of class may come about because of a transformation of meaning. The lack of full differentiation of the two factors, at least with present tests, is also shown by the fact that in three of the lists the variable, Consequences (remote), which is a DMT test for adults, appears. A similar involvement of the two factors in the same tests appears with adult subjects, so the apparent lack of differentiation is not attributable to the age difference of examinees.

Alternate Signs, another DMT test, appears significantly in two of the four analyses, and perhaps for the same reason that Consequences (remote) does in three analyses. Other tests that appear only once are Multiple Grouping (intended as a DMC test), Associational Fluency (a DMR test), and Utility Test (fluency), (a DMU test). Since each appeared in only one of four analyses, perhaps little attention should be paid to these results. Perhaps chance deviations put them over the minimal loading of .30.

It is probably significant, however, that of the two tests intended for this factor the Utility Test is univocal for factor DMC and Alternate Uses is not. The latter test does not function as well in measuring factor DMC for the ninth-grade level as it does for adult males.

Associational Fluency DMR

Sample T		
24.	Simile Insertions	.50 (CMU .35)
3.	Associational Fluency	.45 (DMS .31)
Sample B		
3.	Associational Fluency	.38
1.	Alternate Signs	.37 (DFT .33)
Sample G		
3.	Associational Fluency	.42
24.	Simile Insertions	.32 (CMU .33; EMI .31)
Sample H		
24.	Simile Insertions	.39 (DMS .32)
3.	Associational Fluency	.38 (DMC .36; DMS .34)
2.	Alternate Uses	.35 (DMC .38; DMI .32)
29.	Word Fluency	.32 (DSU .39)
14.	Multiple Analogies	.30 (CMU .33)

Finding synonyms is an ability valued highly by teachers and students of creative writing. It enables the writer to express nuances and saves the reader unnecessary boredom. The factor associational fluency capitalizes on the ability to produce synonyms, as in Associational Fluency, and to produce different descriptions of attributes of an object or person as in Simile Insertions. Except in sample B, both tests serve to define this factor as they have previously (9).

Associational fluency is regarded as factor DMR in the structure of intellect. Giving a variety of synonyms is thought to be an example of completing a relationship, in this case, a relationship of similarity of meaning. Multiple Analogies was designed especially for this study to call for seeing and completing different relationships. It is encouraging that, apparently, when the barrier of language complexity was surmounted, as by the examinees in sample H, this test functioned as intended.

Expressional Fluency DMS

Sample T

7.	Expressional Fluency	.47	(CMU .35)
29.	Word Fluency	.42	(DSU .49)
25.	Simile Interpretations	.36	(DMT .34; EMI? .30)
28.	Utility Test (fluency)	.34	(DMU .50)
5.	Consequences (remote)	.33	(DMC .32)
19.	Plot Titles (low)	.33	(DMU .30; DMI .30)
4.	Consequences (obvious)	.33	(DMU .53; EMI? .31)
3.	Associational Fluency	.31	(DMR .45)

Sample B

7.	Expressional Fluency	.48	
25.	Simile Interpretations	.32	

Sample G

25.	Simile Interpretations	.41	(DMU .33)
7.	Expressional Fluency	.36	(DSU .42)

Sample H

36.	Sex	.48	
7.	Expressional Fluency	.44	
3.	Associational Fluency	.34	(DMC .36; DMR .38)
18.	Planning Elaboration II	.32	(DMI .49)
24.	Simile Insertion	.32	(DMR .39)
25.	Simile Interpretations	.30	(DMI .45)

The factor expressional fluency was initially considered to pertain to symbolic content because most tests of it have required the formation of sentences, and the formation of a sentence is a matter of producing a symbolic structure or system. The combination of words in a sentence requires observation of grammatical rules of word combinations. Grammatical rules pertain to symbolic rather than semantic content. The presence of Simile Interpretations on this factor is reasonable because of its grammatical requirement of building a clause. We have had some misgivings regarding this conclusion, however, for a sentence is also a meaningful system.

Accordingly, for this research effort, we developed two new tests of system construction, clearly symbolic in content in that they involve letters and numbers in non-semantic ways, to determine whether the traditional expressional-fluency tests would go with them on a factor or whether the two groups of tests would separate, indicating two factors, not one. The result was that the two groups of tests separated, leading to the conclusion that expressional fluency is a semantic ability, DMS, and that we have found a new factor, DSS, which will be discussed next. This finding completes the set of six divergent-semantic-production abilities, although more test development is needed to differentiate them as neatly as is desirable.

Factor, DMS, seems central to the essential task in writing, creative or otherwise. It represents the ability to produce coherent discourse. Teachers may not be surprised to learn that ninth-grade students differ from one another in this respect.

It still remains to be seen just what kinds of semantic systems are involved in ability DMS. If the kinds of systems included go so far as scientific models, for example, this is an ability of tremendous importance.

It is of interest that girls of high IQ (indicated by test No. 36 in sample H) score higher in tests of this factor than do boys of high IQ. However, the factor is more clearly differentiated in boys of IQ range 95 - 119, than for girls of the same IQ range. The overall patterns of differentiations attributable to differences in sex will be discussed in a later section.

Divergent Production of Symbolic Systems DSS

Sample T

10.	Make A Code	.48
12.	Match Problems II	.32 (DFT .54)

Sample B

10.	Make A Code	.37
16.	Number Combinations	.35

Sample G

not isolated

Sample H

10.	Make A Code	.40

As mentioned in the discussion of the preceding factor, two new tests were devised to clarify what we had thought was DSS. These two tests were Make A Code and Number Combinations. In Make A Code, the examinee is to invent different cryptographic systems using the letters A through H. Different arrangements of letters were accepted, as were number-for-letter substitutions and substitutions from other notational systems. Number Combinations requires the examinee to make several different equations using only certain numbers.

The factorial evidence admits the contention that some sort of factor, differentiated from the others found in this study, is identifiable by the Make A Code test. Number Combinations functioned as expected in only one analysis. The present results have their greatest importance in leading us to relocate the expressional fluency factor in the semantic category, since the two new tests are clearly uncorrelated with Expressional Fluency and Simile Interpretations. It is apparent that much more work is needed to establish the nature of this factor before attempting to use tests of it as predictors for criteria of interest.

Originality DMT

Sample T

20.	Plot Titles (high)	.44
1.	Alternate Signs	.37 (DMC .34)
25.	Simile Interpretations	.34 (DMS .36; EMI? .30)

Sample B

20.	Plot Titles (high)	.47
5.	Consequences (remote)	.36 (DMC .42)
18.	Planning Elaboration II	.30 (DMU .52)

Sample G

20.	Plot Titles (high)	.40
2.	Alternate Uses	.31 (DMC .33)
1.	Alternate Signs	.31 (DMU .35; DMI .37)

Sample H

20.	Plot Titles (high)	.35
1.	Alternate Signs	.31 (DMU .32; DMC .41)

Originality is considered by many to be the essence of "creativity." Both words represent something desirable, yet both are rather vague ideas. Our previous definition of originality equated it with the production of unusual, or remotely connected, or clever responses.

As the structure-of-intellect notions took form, these kinds of responses seemed to have in common the necessity for a reinterpretation of an object or a situation, or a new, pointed emphasis on one aspect, often slightly incongruous, which sometimes makes the reinterpreted situation laughable if not ludicrous. We placed originality in the cell for divergent production of semantic transformations (DMT), and, for this study, developed a new test specifically oriented to the redefinition or transformations requirement. This test was Alternate Signs, which was based on an earlier test of originality, Symbol Production (2).

Two tests that had previously defined originality were included: Consequences (remote); and Plot Titles (high). The remote score from Consequences is based upon responses obtained from the examinee's relevant digressions from his more immediate experience with the situation described. The high score on Plot Titles is based upon the examinee's production of clever, witty, (including puns), or succinct titles for a short story. The new test, Alternate Signs, requires the examinee to sketch as many as six different simple line drawings to represent a given word. Artistic ability was not considered in the scoring; sketches were counted if they represented, however crudely, an idea distinct from others given by the same examinee.

All three tests intended to measure originality require a relatively long time and much experience to score. We have made several attempts at devising multiple-choice formats for tests of originality, without success.

To return to the research results, Consequences (remote) seems not to measure factor DMT in three of the samples. In sample T, it seemed to measure DMS—expressional fluency, and DMC—spontaneous flexibility; in sample B, it measured factors DMT and DMC; in sample G, EMI—sensitivity to problems, a point to be discussed later; and in sample H, DMC. Evidently for the examinee to obtain a remote response requires of him more the production of classes, or shifts in the sequence of responses, than reinterpretation of a situation. The two factors, now called DMC and DMT, have a history of sharing measures, for example, Consequences (remote), and Alternate Uses, as in sample G.

In summary, Plot Titles (high) is clearly the best test of this factor in these samples. The new test, Alternate Signs, shows a satisfactory consistency, if not uniqueness, but consistently relatively low loadings. Consequences (remote) has been consistently one of the better tests of DMT for adult males, but not so in these samples.

Tests of factor DMT and of factor CMU (verbal comprehension) are clearly distinct in these analyses. This result indicates that tests of DMT will contribute something quite separate from IQ tests in the prediction of performances of ninth-grade students. Predictions of the two kinds of tests in combination should yield more accurate results than predictions based on either type alone, where criteria of performances involve both factors. There are already indications that this is the case in predicting achievement-test scores at the sixth-grade level (22). Getzels and Jackson (3) have shown that a divergent-production score, including an originality component, no doubt, predicts achievement scores as well as do IQ measures.

Adaptive Flexibility DFT

Sample T

17.	Planning Air Maneuvers II	.58	
13.	Match Problems V	.56	
12.	Match Problems II	.54	(DSS .32)
16.	Number Combinations	.47	
14.	Multiple Analogies	.34	(CMU .61)
15.	Multiple Grouping	.32	(DMC .43)

Sample B

12.	Match Problems II	.51	(Sp .55)
17.	Planning Air Maneuvers II	.49	
13.	Match Problems V	.41	(Sp .55)
1.	Alternate Signs	.33	(DMR .37)
15.	Multiple Grouping	.31	

Sample G

13.	Match Problems V	.48	(Sp .33)
17.	Planning Air Maneuvers II	.47	
12.	Match Problems II	.44	(Sp .34)
16.	Number Combinations	.34	(CMU .41)

Sample H

12.	Match Problems II	.53
13.	Match Problems V	.48
17	Planning Air Maneuvers II	.43

It was mentioned earlier that two flexibility factors emerged in the initial study of creativity. The first of these, spontaneous flexibility, was discussed earlier. The second, adaptive flexibility, has been represented in previous studies by Match Problems II and Planning Air Maneuvers II, which serve to define the factor in these samples. The factor is differentiated from others in this study by the tests hypothesized for it; the clearest distinction arises from Sample H. The appearance of a few symbolic and semantic tests in some lists is not easy to explain.

Adaptive flexibility is located in the structure of intellect as DFT. It involves figural content because the definitive tests involve visual forms in space. It is classified as a transformation factor because the examinee must, in Match Problems II and V, revise his conception of the kinds of figures that are acceptable solutions. In Planning Air Maneuvers II, it is presumed that the examinee tries several different revisions of skywriting patterns before deciding on the most efficient one to sketch. These tasks require a transformation of strategy or approach to the specified problem in order to obtain different solutions. Not all changes will serve the purpose, especially not those which would count toward a high "shifts" score as a measure of spontaneous flexibility.

Divergent Production of Figural Implications DFI

Sample T

6.	Decorations	.51	
8.	Figure Production	.47	
22.	Production of Figural Effects	.32	
11.	Marking Speed	.32	(Sd .31)

Sample B

6.	Decorations	.58
22.	Production of Figural Effects	.57
8.	Figure Production	.40

Sample G

6.	Decorations	.44	(FS .34)
8.	Figure Production	.39	
22.	Production of Figural Effects	.34	

Sample H

6.	Decorations	.58
8.	Figure Production	.46
22.	Production of Figural Effects	.39

This factor was hypothesized entirely from the structure-of-intellect model. Part of the interest in its investigation in this study comes from the question of whether the model developed from knowledge of adult factors can predict new factors as well in younger groups.

There were also more specific reasons for including the hypothesized factor DFI. The test, Figure Production, which had been used previously (2), helped define the factor called elaboration. Elaboration had been regarded as a semantic ability, although of the two tests most strongly defining it, one was semantic and the other, Figure Production, had strong figural aspects. It was not certain whether the factor was partly semantic and partly figural or was perhaps a confounding of factors DMI and DFI. The two new tests, Decorations and Production of Figural Effects, are entirely figural in character. We therefore had a test of whether there are two factors or one and, if two, of whether Figure Production would go toward DFI or DMI, or perhaps share variances in both. The results are decisive for two distinct factors and for Figure Production being a figural test, in spite of the fact that in doing this test meaningful objects are drawn.

It is clear that three tests consistently differentiate this ability from others. The justification for placing the ability in the implications category is that in all three tests the examinee starts with limited figural information to which he adds lines suggested by what is given. The additions are figural implications.

It seems reasonable that this factor is closer than its semantic counterpart to the set of "creativity" ratings reported by Lowenfeld (18). Divergent thinking in art may parallel, but certainly is not identical with divergent thinking in other than figural areas. One can question how much transfer, at best, there may be from one content area to another, because the abilities involved are not the same.

Elaboration DMI

Sample T

18.	Planning Elaboration II	.43	
23.	Seeing Problems	.35	(EMI? .38)
19.	Plot Titles (low)	.30	(DMS .33; DMU .30)

Sample B

19.	Plot Titles (low)	.41	(DMU .47)
4.	Consequences (obvious)	.36	(DMU .52)
21.	Possible Jobs	.35	

Sample G

21.	Possible Jobs	.46	
18.	Planning Elaboration II	.42	(DMU .34)
28.	Utility Test (fluency)	.40	(DMU .57)
4.	Consequences (obvious)	.38	(DMU .52)
1.	Alternate Signs	.37	(DMU .35)
19.	Plot Titles (low)	.32	(DMU .34)

Sample H

21.	Possible Jobs	.59	
18.	Planning Elaboration II	.49	(DMS .32)
25.	Simile Interpretation	.43	(DMS .30)
28.	Utility Test (fluency)	.40	(DMC .30)
15.	Multiple Grouping	.33	
19.	Plot Titles (low)	.33	(DMU .46)
4.	Consequences (obvious)	.32	(DMU .46)
2.	Alternate Uses	.32	(DMR .35; DMC .38)

The factor called elaboration was first delineated in the study of planning (2), where it was characterized as the ability to suggest relevant details for a plan to meet a given situation. Such details seemed to be implications, in the sense that they were necessary consequences of given information, or necessary antecedents to a stated goal. The two tests defining the factor were Planning Elaboration and Figure Production. Because it was suspected that in this study Figure Production might go instead to the newly hypothesized DFI factor, we devised a new test, Possible Jobs, as a companion to Planning Elaboration II.

In samples G and H, the two tests functioned as intended, Possible Jobs being loaded on this factor only. In sample G, Planning Elaboration II showed some relationship to DMU, and in sample B, it had two components, DMU and DMC. The new test, Possible Jobs, loaded uniquely on the present factor in sample B as well as in G and H.

The results from sample T require an almost arbitrary choice of label for the factor led by Planning Elaboration, for two reasons: Possible Jobs leads on another factor, and Seeing Problems was hypothesized as a marker test for EMI, previously sensitivity to problems, but has two components in this sample. Our decision was based upon the history of Planning Elaboration II and the contingency that Possible Jobs, whose factor we label next as EMI, may require some kind of evaluation, whereas Planning Elaboration II seems much less likely to do so.

It is apparent that elaboration, in this study, is not clearly differentiated from other divergent-production factors, especially DMU. Reasons for this were mentioned in discussion of that factor.

Sensitivity to Problems EMI

Sample T

21.	Possible Jobs	.54	
23.	Seeing Problems	.38	(DMI? .35)
2.	Alternate Uses	.34	(DMC .45)
4.	Consequences (obvious)	.31	(DMU .53; DMS .33)
25.	Simile Interpretation	.30	(DMS .36; DMT .34)

Sample B

23.	Seeing Problems	.49	
24.	Simile Insertions	.40	(CMU .33)

Sample G

24.	Simile Insertions	.31	(CMU .33; DMR .32)
23.	Seeing Problems	.30	
5.	Consequences (remote)	.30	

Sample H

23.	Seeing Problems	.40	(FS .32)

The factor called sensitivity to problems is considered one of the important components of creativity. We included one of its usual marker tests, Seeing Problems, to see whether any of the divergent-production tests would have variance in common with it. Sensitivity to problems is classified as an evaluation factor, EMI, based on the requirement its usual tests make, to see that a situation is defective or deficient.

Fortunately, although the only test representing its factor, Seeing Problems emerged as expected in all four samples, although not uniquely so in samples T and H, and it stands alone as a singlet in sample H.

We may conclude that ninth-grade students do differ with respect to this ability, and that divergent-production tests have relatively little in common with sensitivity to problems as measured in this study.

Verbal Comprehension CMU

Sample T

14.	Multiple Analogies	.61	(DFT .34)
35.	Verbal Comprehension	.60	
24.	Simile Insertions	.35	(DMR .50)
7.	Expressional Fluency	.35	(DMS .47)

Sample B

31.	SAT Paragraph Meaning	.65	
30.	SAT Word Meaning	.60	
14.	Multiple Analogies	.48	
24.	Simile Insertion	.33	(EMI .40)

Sample G

31.	SAT Paragraph Meaning	.55	
30.	SAT Word Meaning	.53	
14.	Multiple Analogies	.48	
16.	Number Combinations	.41	(DFT .34)
26.	Suffixes	.34	(DSU .40)
24.	Simile Insertion	.33	(EMI .31; DMR .32)

Sample H

32.	CAT Reading Vocabulary	.52	
33.	CAT Reading Comprehension	.35	(FS .31)
14.	Multiple Analogies	.33	(DMR .30)

With so many verbal tests, those in which word meanings are important, in a battery, some of them are likely to involve individual differences in word knowledge, unless the demands in this respect are kept at a minimal level. Word knowledge is the essence of the factor CMU—verbal comprehension. The marker test for this factor in sample T was Verbal Comprehension, a vocabulary test, and in the other three samples, two typical tests of the factor, a vocabulary test and a reading-comprehension test in each case. The results show that few of the tests, other than the marker tests, had significant loadings on factor CMU. All are verbal, with the exception of Number Combinations. It is possible that success in the latter test is facilitated by the strategy of verbalizing the number material.

Two tests deserve comment because they had significant CMU variances in three or four of the samples—Multiple Analogies and Simile Insertion. Multiple Analogies was designed for the factor DMR—associational fluency. Generally it was not found related to that factor, an interesting exception being in sample H. It is probable that most examinees of the H sample had sufficient verbal comprehension to meet the requirements of this test. In this sample the CMU variance in the test was much lower than in the other groups. In sample T the proportion of variance in CMU was greatest, as we should expect. Simile Insertions involved significant CMU variances in all but sample H, but less than did Multiple Analogies in any group

Finger Speed FS

Sample T

not found

Sample B

11.	Marking Speed	.32

Sample G

11.	Marking Speed	.40
6.	Decorations	.34 (DFI .44)
15.	Multiple Grouping	.33

Sample H

37.	School	.49
11.	Marking Speed	.34
23.	Seeing Problems	.32 (EMI .40)
33.	CAT Reading Comprehension	.31 (CMU .35)

Because most of the divergent-production tests required many written responses, we wished to control for differences in writing speed. Test No. 11, Marking Speed, has been used before for such a purpose and was included in this study with the results shown above.

In sample T we were unable to find a dimension having Marking Speed in the lead. The test loaded on a doublet with Numerical Operations and on the factor of divergent production of figural implications. In sample B, although there were individual differences with respect to the test, the boys' scores on the other tests did not correlate very highly with Marking Speed. For girls, sample G, Marking Speed, was somewhat involved in two other tests. The results from Sample H, appear to be confounded with differences in school, No. 37, which was introduced because we sensed some difference in the motivating attitudes at the two schools in which we tested. It may be that Marking Speed can give some indication of differential motivation, but such an interpretation should be based on more than the test administrator's subjective judgment as a criterion.

Sex Membership

Sample T

36.	Sex	.45

We were able to investigate the concomitants of sex differences in two ways in this study. From the larger school we could compare sample B—boys, IQ 95 to 119 and sample G—girls, IQ 95 to 119. In sample T and sample H we included sex membership as a variable for analysis. In sample T this variable, No. 36, emerged as a singlet and had no significant loadings on the other factors. In sample H the sex-membership variable had its only significant loading on expressional fluency.

A comparison of the differentiation of factors in sample B with that in sample G indicates no anomalies meriting further concern, with the single exception of divergent production of symbolic systems, DSS, the new and unexpected factor, which was found clearly in the case of boys, sample B, not at all in the case of girls, sample G. The sex-membership variable did not load significantly on DSS in either sample T or sample H.

An inspection of the correlations of variate No. 36 with all aptitude tests in the total sample from the large school showed boys with a significantly[3] higher mean on Planning Air Maneuvers and the two Match Problems tests, all for factor DFT (adaptive flexibility), Utility Test (shifts) for DMC (spontaneous flexibility), and Multiple Analogies, mostly CMU (verbal comprehension). Girls had significantly higher means on two or more tests of DMU (ideational fluency), DMS (expressional fluency), DSU (word fluency), and EMI (sensitivity to problems), and on one test, Decorations, for factor DFI. It must be noted that the highest correlation had an absolute value of .23 so that one should not count on predicting aptitudes from sex membership.

[3]Probability of exceeding the obtained value of the point-biserial r is approximately .05, based on the corresponding values of Student's t.

Specific Sp

Sample T

not found

Sample B

12.	Match Problems II	.55 (DFT .51)
13.	Match Problems V	.55 (DFT .41)

Sample G

12.	Match Problems II	.34 (DFT .44)
13.	Match Problems V	.33 (DFT .48)

Sample H

not found

Tests may correlate with each other because they all require the same ability, or among other reasons, because of strong similarities in content and format. Alternate forms of the same test naturally correlate more with each other, in general, than with other tests requiring the same common-factor ability. Such seems to be the case with the two Match Problems tests in this study, although they are not, strictly speaking, alternate forms.

The delineation of the ability DFT, which they share with Planning Air Maneuvers II, was improved in samples B and G by isolating what we call here a specific factor. In samples T and H, such a specific factor was not evident. It is probable that the relatively higher loadings in the Match Problems tests in samples T and H are due to a fusing of specific overlap with the common-factor (DFT) variance.

Speed Doublet

Sample T

34.	Numerical Operations	.46
11.	Marking Speed	.31 (DFI .32)

This is an unexpected doublet factor that cannot be easily interpreted. The two tests have something uniquely in common, but the only apparent link is speed of work. Although sample T was the only one not showing a finger-speed factor, it seems unlikely that this is a finger-speed dimension, for Numerical Operations should have little or no finger-speed variance. The answers were merely marks as on an answer sheet, taking minimal proportion of the testing time. A motivational hypothesis could be entertained for this factor, but there is no direct support for it.

Resume of Factor-Analytic Results

In the preceding paragraphs, the obtained factors were presented in a way to facilitate comparisons across the four samples analyzed separately. With the exceptions of one new factor, DSS, and those arising from minor differences in batteries, the obtained intellectual common factors exhibit a satisfying consistency. All factors hypothesized were found in all samples, identified in the main by the same tests.

The abilities represented by the obtained factors in this study include all those in the semantic sector of divergent-producting thinking in the structure-of-intellect model. One new factor, DFI, was hypothesized entirely from the model and the hypothesis was verified. A second new factor, DSS, for which the evidence is still rather tentative, emerged as a trace of an ability that fits nicely into the model. The obtained common factors are, in familiar terms: ideational fluency, word fluency, spontaneous flexibility, associational fluency, originality, adaptive flexibility, elaboration, sensitivity to problems, verbal comprehension, and the two new ones, divergent production of figural implications and divergent production of symbolic systems. The sex-membership variable defined a factor only in the total-range-IQ sample, although it was present as well in the High-IQ battery.

Inspection of the rotated factor matrices, Tables 10 through 13, indicates that most the the tests, especially those leading on their factors, have low complexity. On this basis, one may infer that the obtained factors are essentially independent; except where groups of tests are loaded on two factors, measures of ability in the one will not predict ability in the other to any useful degree. Almost every common factor in all four samples has zero loadings in representative tests from most other factors in the battery. The dimensionality of the divergent-production aspects of intellect seems as great in ninth-grade examinees as in adults, assuming that results from previous studies of adults would be reaffirmed with the present battery. This assumption seems tenable, since most of the tests are minor modifications of instruments that did identify the same factors in young-adult-male samples.

As noted in the previous section on analysis, we obtained varimax analytic rotational solutions for these data. In general, those solutions exhibited fewer clearly identifiable factors; some factors had larger groups of tests loading on them, while some were represented by just one test, thus making identification in terms of common variance almost impossible. Further, the consistency of the varimax-rotated factors from one sample to another was, in our subjective opinion, not as great as that of the results of graphic rotations presented in this report.

The evidence available from these four analyses lends confidence to the hypothesis that marked differentiation in intellectual abilities is possible at the ninth-grade level. Of course, the present results do not bear directly on areas of the structure-of-intellect model other than divergent production, but the success reported here augurs well for similar differentiability in other aspects of intelligence.

Attributes of the "Gifted" Group

We turn now from the factor-analytic results to the comparison of the "Gifted" group with an unselected one. The results of the comparisons are given in Table 14. The "Gifted" group, N = 45, was defined in terms of a CTMM IQ of 130 or greater, a definition consistent with the practice of the California State Board of Education.

Comparisons of means of "Gifted" scores with means of scores of the total group (including the "Gifted") indicate that the "Gifted" group obtained significantly higher means on about half of the aptitude tests. The tests on which the "Gifted" group obtained significantly higher scores can be grouped into two meaningful combinations. Four of the tests involved the production or evaluation of implications. Four tests (Match Problems II, Match Problems V, Alternate Uses, and Multiple Grouping) are tests for flexibility factors, the first two for adaptive flexibility and the last two for spontaneous flexibility. The two tests for DMR, on which the "Gifted" group obtained significantly higher scores, have strong verbal-comprehension components (CMU) which probably account for the observed differences.

While the "Gifted" group obtained significantly higher scores on tests involving elaboration and flexibility, it should be noted that the correlations of these tests with IQ are not sufficiently high for efficient prediction. The CTMM IQ score could not be used effectively to select persons high in flexibility or in abilities to produce or evaluate implications.

Table 14

Comparisons of "Gifted" Sample with "Total"

	M_P[a]	M_G	σ_P	σ_G	t
1. Alternate Signs	11.83	12.18	3.73	.56	.63
2. Alternate Uses	19.23	21.76	7.75	1.17	2.16*
3. Associational Fluency I	10.88	11.33	3.77	.57	.79
4. Consequences (obvious)	25.53	22.40	8.47	1.28	-2.45*
5. Consequences (remote)	4.21	4.87	3.21	.48	1.38
6. Decorations	45.20	49.40	12.05	1.82	2.31*
7. Expressional Fluency	27.77	31.27	12.19	1.84	1.90
8. Figure Production	35.45	35.11	8.34	1.26	-.27
9. Ideational Fluency	53.38	53.31	13.17	1.99	-.04
10. Make A Code	9.49	9.98	2.84	.43	1.14
11. Marking Speed	54.37	53.87	9.16	1.38	-.36
12. Match Problems II	7.53	11.78	3.76	.57	7.46**
13. Match Problems V	10.24	13.60	4.19	.63	5.33**
14. Multiple Analogies	13.94	19.20	4.92	.74	7.11**
15. Multiple Grouping	6.90	8.38	2.44	.37	4.00**
16. Number Combinations	14.84	18.22	4.74	.71	4.76**
17. Planning Air Maneuvers	33.88	36.38	10.48	1.58	1.58
18. Planning Elaboration II	30.64	33.68	8.66	1.31	2.32*
19. Plot Titles (low)	11.29	10.09	5.48	.83	-1.45
20. Plot Titles (high)	3.76	4.40	2.24	.34	1.88
21. Possible Jobs	17.36	19.47	5.84	.88	2.40*
22. Prod. Fig. Effects	32.60	31.29	7.27	1.10	-1.19
23. Seeing Problems	28.85	33.04	8.26	1.24	3.38**
24. Simile Insertions	11.52	14.00	4.85	.73	3.40**
25. Simile Interpretations	7.98	8.11	3.45	.52	.25
26. Suffixes	13.15	13.78	4.83	.73	.86
27. Utility Test (shifts)	7.08	8.60	5.74	.86	1.77
28. Utility Test (fluency)	23.53	22.80	8.10	1.22	-.60
29. Word Fluency	46.68	49.96	10.21	1.54	2.13*

[a] M refers to Mean; σ refers to standard deviation; t refers to Student's t-ratio; P refers to total group from the larger high school, N = 639; G refers to "Gifted," N = 45.

* Probability of t is less than .05

** Probability of t is less than .01

SUMMARY AND CONCLUSIONS

In the preceding paragraphs, we have discussed the many similarities and occasional differences in the results of analyzing the same tests administered to different samples of ninth-grade students. The examinees were drawn from one large and one small junior high school in Southern California. The tests required a total of six hours to administer, three sessions of two hours each at one school, and two sessions of three hours each at the other.

The samples were differentiated by sex and IQ, as follows: sample T, boys and girls, no selection on IQ, N = 204; sample B, boys, IQ 95 to 119, N = 229; sample G, girls, IQ 95 to 119, N = 228; and sample H, boys and girls, IQ 120 or higher, N = 216.

Eleven aptitude factors were investigated by including tests hypothesized to measure them. Tests modified from adult forms were scored in essentially the same way as they would have been for adult responses. For the new tests, scoring guides developed during pretesting proved to be adequate.

Eleven factors were found in all four samples, with minor differences, and could be identified as corresponding to abilities previously defined or expected for adults, each fitting an appropriate cell in the structure-of-intellect model.

Four tests hypothesized to measure expressional fluency split, giving rise to one ability for dealing with semantic systems and one for symbolic systems. Such a separation is consistent with expectation. Measures of sex, school, and finger speed were included as statistical controls for individual differences in those respects which might affect performance on the aptitude tests.

The major criteria for the rotated factor solutions were positive manifold and simple structure. In most cases, psychological meaningfulness guided the final rotations, where options within the simple-structure criterion existed.

In an earlier section we presented general and specific hypotheses for investigation. We shall discuss the general hypotheses first and then examine the specific ones. Our first hypothesis was to the effect that the abilities our tests should differentiate in an adult sample would likewise be differentiated in ninth-grade students. The evidence almost entirely supports this hypothesis, with respect to all four samples investigated. Although some of the tests were not univocal in all samples, neither have they always been so with adults. The existence of factors as separate entities is quite clear.

Our second hypothesis stated that the factor structure would be the same for boys as for girls. Again, we find liberal support for this hypothesis, in the comparison of samples B and G, with the exception that the new DSS (divergent production of symbolic systems) was clearly in evidence for boys, but not for girls. Instead, in sample G, one of its tests split between CMU (verbal comprehension) and DFT (adaptive flexibility), and the other had no significant loadings on any factor. The other ten aptitude factors are very similar in the two samples.

As to sex differences, very few significant differences were apparent. Of the few that did occur, it appears that boys do a little better on tests of flexibility, whereas girls do better on tests of fluency.

As our third hypothesis for investigation, we stated that selection on IQ would not make a difference in factor structure. This hypothesis is especially germane since our selection of tests had been made in terms of factorial studies of adult males of above-average intelligence. By comparing the results from sample T with those from sample H, we see a marked similarity that leads us to accept our third conjecture. Further confirmation is available from the similarity of the results of sample H to those from B and G, which were of IQ 95 to 119. These findings give us confidence that the great majority of tests used in this study are suitable for differentiating the abilities they measure in ninth-grade students at all levels of IQ above 95.

From the factor-analytic results we can recommend tests for all the abilities except DSS, for which the findings are not sufficiently clear. Our recommendations are collected in Table 15. The factors are designated by the structure-of-intellect code, the tests by name, and the factorial validity of each test by its loading on the factor, for each sample. It can be seen that the factorial validities differ somewhat from sample to sample. The only apparent trend of differences is for slightly higher loadings for sample T. This could have been expected, in view of the wider range of IQ in that group. Reference to Table I shows that the reliabilities differ among samples to about the same degree as do factor loadings.

Our fourth hypothesis stated that the level of performance of a "gifted" group, IQ 130 or higher, would not differ from that of a group unselected on IQ. The evidence, from comparing a "gifted" group of 45 with an unselected group of 639, of which the "gifted" were a part, indicates that the "gifted" group performed significantly better in general on tests of producing or evaluating implications, on tests of both adaptive and spontaneous flexibility, and possibly on tests of associational fluency.

Our results indicate the following major conclusions:

(1) Divergent-production aptitudes can be differentiated in ninth-grade students, almost as in adults.

(2) Only minor differences in factor structure were evident between samples selected on sex and IQ; the dominant tests on each factor almost always appeared on corresponding factors in all samples.

(3) At least one test can be recommended for each of ten of the eleven abilities differentiated. Factorial validities range from the high .30's to the high .50's for divergent-production abilities, and slightly higher on verbal comprehension. Factorial validities are relatively constant across all samples.

From these findings, several implications ensue. Special programs in schools for those well above average in divergent-production abilities may prove as successful as those now available for those of high IQ. That different children will be selected for each kind of ability is indicated by the separateness of the factors and the univocality of the tests.

The functions of academic and vocational counseling may be extended, as more differentiating information is applied to the dual objectives of guidance, selection, and placement.

The possibility of early identification of creative talent is increased. Such identification is relevant to the broad national needs and to the interest of higher education in selecting students for honors programs.

The demonstration of differentiation at the ninth-grade level adds to the knowledge of intellectual development, and may spur the search for the genesis of the various kinds of individual differences.

Some further research should be directed toward the following objectives: to ascertain whether abilities other than those related to divergent production can be differentiated at the junior-high-school level; to explore the differentiation of abilities at younger age levels; to determine the predictive validity of tests of divergent-productive thinking, and other abilities for predicting criteria based on academic and vocational performance.

Factor analysis, used in exploratory experimental test development, will provide further evidence serving to enhance our understanding of the child.

TABLE 15

Recommended tests for each aptitude factor with loadings by sample.

Factors	Tests	Test No.	Loadings by Sample T	B	G	H
DMU	Ideational Fluency	9	.46	.50	.47	.43
DSU	Suffixes	26	.51	.46	.40	.54
	Word Fluency	29	.49	.51	.51	.39
DMC	Utility Test (shifts)	27	.40	.45	.49	.57
DMR	Associational Fluency	3	.45	.38	.42	.38
DMS	Expressional Fluency	7	.47	.48	.36	.44
DSS	None sufficiently clear					
DMT	Plot Titles (high)	20	.44	.47	.40	.35
DFT	Match Problems II	12	.54	.49	.44	.53
	Match Problems V	13	.56	.51	.48	.48
DFI	Decorations	6	.51	.58	.44	.58
	Figure Production	8	.47	.40	.39	.46
DMI	Possible Jobs	21	.14[a]	.35	.46	.59
EMI	Seeing Problems	23	.38	.49	.30	.40
CMU	GZAS Verbal Comprehension	35	.60	---[b]	---	---
	SAT Word Meaning	30	.60	.65	.55	---

[a]DMI and EMI were confounded in sample T, leading to this low validity coefficient.

[b]Dashed entries indicate the test was not present in the battery analyzed for that sample.

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APPENDIX

DESCRIPTION OF TESTS[1]

1. Alternate Signs - DMT02A.* Draw different symbols or signs to express the meaning of a given word. Score: one point for each different illustration which conveys the meaning of the given word.

   Parts, 2. Items per part, 3. Working time, 6 minutes.

2. Alternate Uses - SSC Form A - DMC. List as many as six different uses for common objects. Score: one point for each use which does not duplicate any other use listed. Uses may refer to different interpretations of the given object.

   Parts, 3. Items per part, 3. Working time, 12 minutes.

3. Associational Fluency I - SSC Form A - DMR. Write synonyms for given words. Score: one point for each different word listed. Remotely associated words are acceptable.

   Parts, 2. Items per part, 1. Working time, 4 minutes.

4. Consequences (obvious) - SSC Form AA - DMT. List many different results which would be associated with a new and unusual situation. Score: one point for each response which would be a direct result of the given situation, including very general results.

   Parts, 5. Items per part, 1. Working time, 10 minutes.

5. Consequences (remote) - SSC Form AA - - DMT. List many different results which would be associated with a new and unusual situation. Score: one point for each response that indicates an indirect result or an unusual adaptation to the given situation.

   Parts, 5. Items per part, 1. Working time, 10 minutes.

6. Decorations - DFI02A. Decorate two identical outline drawings differently. Score: ratings, ranging from one to four, of each different decorative element produced. Each element is rated according to the amount of detail and complexity. There is a penalty for drawing meaningful elements.

   Parts, 4. Items per part, 1 (each item has two identical drawings). Working time, 12 minutes.

7. Expressional Fluency - SSC Form A - DSS. Write many different four-word sentences using a given set of initial letters. Score: one point for each different word used in a complete sentence.

   Parts, 4. Items per part, 1. Working time, 8 minutes.

8. Figure Production - DMI02B. Add to given lines in order to produce a meaningful figure. Score: each item is rated from one to five for increasing amount of relevant detail produced.

   Parts, 3. Items per part, 4. Working time, 9 minutes.

9. Ideational Fluency - SSC Form AA - DMU. List things that belong to a broadly defined class. Score: one point for each different thing listed which belongs in the specified class.

   Parts, 4. Items per part, 1. Working time, 12 minutes.

10. Make A Code - DSS03A. Make as many as twenty different codes which apply to the English alphabet, using numbers or letters or a combination of both. Score: one point for each different principle used in the codes.

    Parts, 1. Items per part, 1. Working time, 5 minutes.

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[1] The revision of adult forms of tests and the development of new ones was aided markedly by the diligent efforts of Arthur S. Gershon and Sheldon F. Gardner.

* In the code designations of the tests, the first three letters refer to the hypothesized factor content of the test, with these exceptions: SSC, for tests published by Sheridan Supply Company; GZAS, for Guilford-Zimmerman Aptitude Survey, also published by Sheridan Supply Company; V, for non-intellectual factors; and no code designations for standardized achievement tests, Numbers 30, 31, 32, and 33. Factors are described in the body of the report, page 6, and tests listed by factor.

11. Marking Speed - V03A. Make X's as rapidly as possible to fill the squares provided. Score: total number of complete X's divided by 3.

    Parts, 2. Items per part, 1. Working time, 2 minutes.

12. Match Problems II - DFT02B. Remove a specified number of matches (sides) from a given pattern of squares or triangles and leave a specified number of squares or triangles. Several different solutions are required for each set of specifications. Score: one point for each different solution that satisfies all requirements.

    Parts, 2. Items per part, 5. Working time, 14 minutes.

13. Match Problems V - DFT05B. Remove a specified number of matches from a given pattern of squares to make a new pattern of squares. Give different solutions for the same given pattern of squares, each solution based on a different rule. Score: one point for each different solution that satisfies all requirements.

    Parts, 2. Items per part, 3. Working time, 10 minutes.

14. Multiple Analogies - DMR02A. Show several different relationships between a given pair of objects by completing several analogies for which the first word is given. Score: one point for each different relationship indicated.

    Parts, 2. Items per part, 4. Working time, 10 minutes.

15. Multiple Grouping - DMC02B. Given seven objects, find many groups of 3 or more objects. Use a different principle for each group. Score: one point for each acceptable group of 3 or more, plus one point for each appropriate object over 3 listed in acceptable groups.

    Parts, 2. Items per part, 1. Working time, 4 minutes.

16. Number Combinations - DSS02A. Write many different equations using only given numbers and rules. Score: one point for each correct equation.

    Parts, 2. Items per part, 3. Working time, 8 minutes.

17. Planning Air Maneuvers - DFT01B. Indicate the most efficient path in "skywriting" letter combinations. Score: every possible position has a score value assigned according to its relative efficiency. Scores range from one to five for each item. (Note: this is a radically different scoring system than that used in previous studies.)

    Parts, 2. Items per part, 6. Working time, 12 minutes.

18. Planning Elaboration II - DMI01A. Fill in as many details as necessary to make a briefly outlined activity work. Score: one point for each different detail listed.

    Parts, 2. Items per part, 1. Working time, 16 minutes.

19. Plot Titles (low) - DMT01D. Write as many titles as you can for a short story plot. Titles may be clever or not; the only requirement is that they must be clearly related to the plot. Score: one point for each title which is not remote.

    Parts, 2. Items per part, 1. Working time, 6 minutes.

20. Plot Titles (high) - DMT01D. Write as many titles as you can for a short story plot. Titles may be clever or not; the only requirement is that they must be clearly related to the plot. Score: one point for each title that is especially succinct, remotely but cleverly related to the plot, or indicates a reinterpretation of the plot by a new emphasis.

    Parts, 2. Items per part, 1. Working time, 6 minutes.

21. Possible Jobs - DMI03A. Write as many as six different jobs which might be indicated by a pictured emblem. Score: one point for each relevant job listed.

    Parts, 2. Items per part, 3. Working time, 10 minutes.

22. Production Of Figural Effects - DFI01A. Add detail to a simple given figure, without drawing real objects. Score: sum of ratings assigned by item. Ratings are based on a detailed guide and range from one to four each item.

Parts, 2. Items per part, 6. Working time, 6 minutes.

23. Seeing Problems - EMG01B. List as many as 5 different problems connected with a common object. Score: one point for each problem listed which deals with the structure, use, or operation of the object.

Parts, 4. Items per part, 3. Working time, 12 minutes.

24. Simile Insertions - DMR01B. Write different adjectives to complete a simile. Score: one point for word listed which is appropriate to both referents in the given simile.

Parts, 2. Items per part, 2. Working time, 4 minutes.

25. Simile Interpretations - DSS01B. Complete in a different way a sentence that states an analogous idea. Score: one point for each completion which is related to both parts of the given clause.

Parts, 2. Items per part, 2. Working time, 4 minutes.

26. Suffixes - DSU01A. Write words ending with a specified suffix. Score: one point for each word listed.

Parts, 1. Items per part, 1. Working time, 4 minutes.

27. Utility Test (shifts) - DMC01A. List many different uses for a common object. Score: the number of shifts in category among acceptable responses.

Parts, 2. Items per part, 1. Working time, 10 minutes.

28. Utility Test (fluency) - DMC01A. List many different uses for a common object. Score: the number of acceptable responses.

Parts, 2. Items per part, 1. Working time, 10 minutes.

29. Word Fluency - SSC Form A - DSU. Write words containing one specified letter. Score: one point for each different word written which contains the specified letter.

Parts, 2. Items per part, 1. Working time, 4 minutes.

30. Stanford Achievement Test—Word Meaning - CMU.

31. Stanford Achievement Test—Paragraph Meaning - CMU.

32. California Reading Test—Vocabulary - CMU.

33. California Reading Test—Comprehension - CMU.

34. Numerical Operations - GZAS Part III Form A - MSI. Add, subtract, or multiply numbers. Score: number right minus the number wrong.

Parts, 1. Items per part, 132. Working time, 8 minutes.

35. Verbal Comprehension - GZAS Part I Form A - CMU. Select from a group a word that is about the same as a given word. From the Guilford-Zimmerman Aptitude Survey. Score: the number of correct responses, corrected for chance success.

36. Sex - Boys were given a "score" of 1; girls were given a zero. This variate was included as a statistical control for the effects of sex differences on aptitudes. It was reflected after rotations in samples T and H for easier interpretation.

37. School - One school was given a "score" of 1; the other zero. This variate was included as a statistical control for the effects of differences between schools.